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A FEW NOTES REGARDING THE HISTORY OF SHALLOW RIVER NAVIGATION.

In reference to the descriptions given in this issue of the very latest types of vessels built for the purpose of shallow river navigation, it may not be uninteresting to go back to the history of steam navigation specially adapted for shallow rivers.

In the year 1737, Jonathan Hull invented and built a remarkable vessel, which he called "A machine for carrying ships in and out of harbor against wind and tide." This consisted of a wooden hull and a paddle wheel without any rims, the supports for which projected from the stern of the vessel. We believe it may be said that this stern-wheel vessel is the prototype of all steam vessels.

THE CHARLOTTE DUNDAS.

In 1803, Symington produced what was termed at the time "The first practical steamboat," which was named the *Charlotte Dundas*. This vessel, which was also a stern-wheel boat, had a paddle box embodied in the after part of the hull.

Four years later the *Clermont* was built by Fulton. This boat was a side-paddle boat, a type which is now so much more familiar to the general public than that of the older stern-wheel boats.

In 1817, Henry Bell, whose name is almost as familiar as that of Watt, built a vessel called the *Comet*, which is also a side-wheel boat; and it is very familiar to all those who have visited the Scottish Historical Exhibition, there being two models exhibited there, one in the Kelvin Hall, and the other afloat in the river Kelvin.

These two methods of propulsion gradually developed until a side-wheel vessel, called the *Scotia*, was built, which crossed the Atlantic in about twelve days; but, with the exception of vessels built for short passages, such as from Dover to Calais or from England to the Channel Islands, the screw propeller has now practically ousted this form of propulsion.

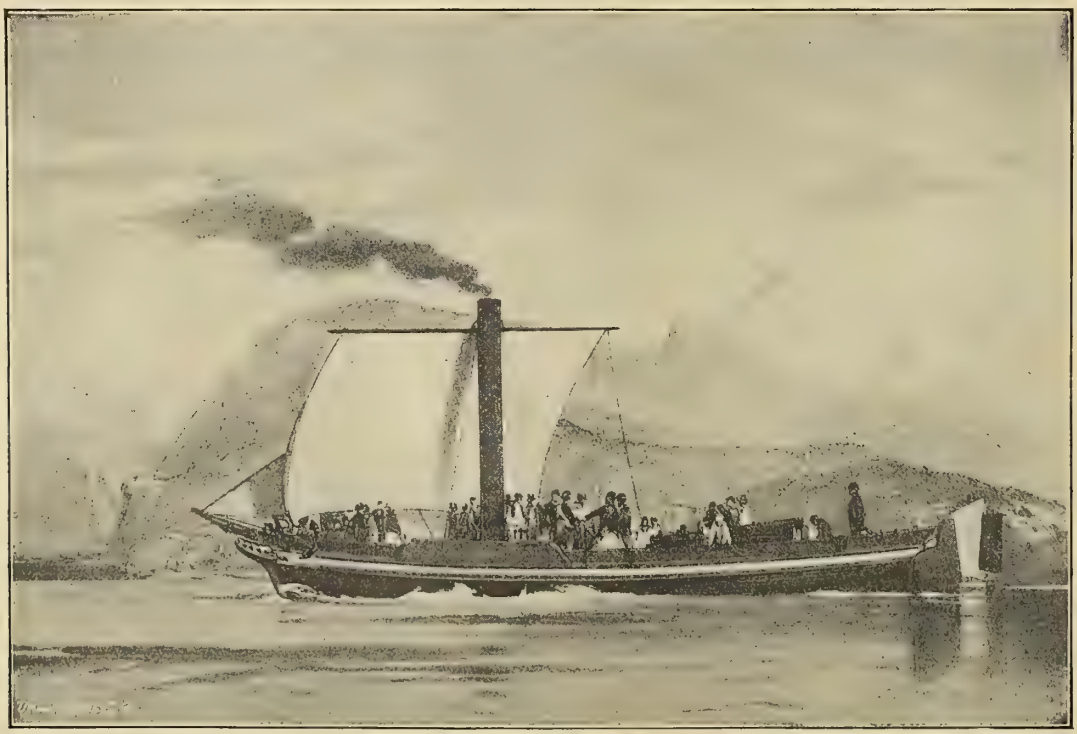
In 1856, John Buchanan introduced a device by means of which a screw propeller could be used with advantage for vessels of very shallow draft. The propeller revolves in an arched tunnel, built up from the bottom of the hull, the bottom of the tunnel being open to the water. The tunnel on cross section has vertical sides and semi-circular top.

This method of a propeller working in a tunnel had an advantage because a fast-running engine could be used, being very much lighter than the slow-running machinery used in the case of either the stern-wheel or side-wheel boat. A certain number of vessels were built from time to time on this method, but the objection to it was that, when the vessel was loaded below its light draft, the after part of the tunnel produced a very serious resistance to the speed of the vessel, and for this reason the system fell out of use. It was again introduced by Messrs. Yarrow in 1892, and a good many fairly

THE CLERMONT.

successful boats up to 100 feet by 20 feet were constructed. In the case of pleasure boats and gunboats, in which the draft of water was scarcely varied, these boats were very successful, but when it came to boats of varying draft the resistance of the after portion of the tunnel had to be considered. This trouble arose only when the vessel was deeply laden. This difficulty was overcome by the builders in a very simple manner by making the after part of the tunnel work on a hinge, so that the rear portion of it could be adjusted to touch the surface of the water, without being immersed in it, on whatever draft the vessel might be running, a device which has proved very successful. Not only does this adaptability of the after part of the tunnel to various drafts increase the speed when the vessel is laden without necessitating extra power, but even on a light draft it is a great advantage, because, when the propeller is at work, it raises a mound of water behind it, and the tunnel can be adjusted to touch the top of this mound, which is often a good many inches above the level of the water outside.

Many gunboats have been built on this system for the



THE COMET.

British and other governments. Besides *Macau,* built for the Portuguese government, and the *Widgeon,* the last of eleven gunboats built on this system for the British Admiralty, a similar boat was built for the Japanese government and sent in pieces to be riveted together in Japan. This boat left the country just before the declaration of war between Russia and Japan, and every effort was made by the Russians to have it stopped. During the voyage out of the freight steamer through the Red Sea the latter was overhauled by the Russian gunboat, whose captain had been informed that a Japanese gunboat was on board. The officers searched the freight vessel, but seeing nothing but wooden cases returned with the report that no gunboat was on board. The freight steamer's destination was Hongkong, and there the British authorities had orders to stop her and take out the gunboat. The captain of the freight vessel, however, had secret orders to proceed direct to Japan, without calling at Hongkong, and so the shipment safely arrived at its destination and was riveted together by the Japanese.

The importance of shallow-draft vessels can hardly be overestimated. In geography books the rivers in various countries are described as being navigable up to a certain point, and the function of the shallow-draft boats is to carry this point further to the source. We may state that these vessels have been sent on expeditions among the primeval forests of Africa, where dwell the dwarf races. They have been sent into the mountains of Peru, where white men have never been before and where the natives are in the Stone Age. These people wear no clothes and know no weapons but stone axes and poisoned arrows, and are shot at sight like wild beasts by the half-civilized natives of the surrounding regions. They have also advanced along the shallow tributaries of the Amazon, which are practically unknown to civilization, and where the natives are scarcely superior to those mentioned above. The natives of these regions are very fierce and disfigure their faces in every kind of grotesque manner.

If a history could be written, giving the combined experience of those who have accompanied these boats, it would be a very interesting one, as illustrating the very first introduction of civilization to the naked savage.

American River Steamer Saguenay.

The Richelieu & Ontario Navigation Company's new steamer *Saguenay* was constructed at the Fairfield Shipyard, Glasgow. The *Saguenay* is 275 feet in length, 56 feet 6 inches in breadth, and 40 feet in depth to hurricane deck. She is fitted with two direct-acting, triple-expansion surface-condensing engines, each having four inverted cylinders, with cranks on the Yarrow-Schlick-Tweedy system of balancing. One of the low-pressure cylinders is at the forward end, and next to it is the high-pressure, then comes the intermediate-pressure cylinder, with the second low-pressure at the aft end. The engines are designed to develop a total of 2,300 indicated horsepower when driving the ship at 15 knots sea speed on a draft of 10 feet.

As is usual in American river passenger steamers the starting platform is situated at the level of the main deck within the engine-room casing, and the gear is so arranged that both sets of machinery can be conveniently operated by the engineer in charge.

The steam generating plant consists of three single-ended boilers of the multi-tubular type, each designed for a working pressure of 180 pounds per square inch. All the furnaces are of the suspension bulb type, working under Howden's system of forced draft.

The electric generating plant consists of two sets, manufactured by Allen, of Bedford. Each set is constructed for a continuous output of 75 kilowatts at 100 volts when running at a speed of 500 revolutions per minute.

CHAIN AND ROPE TOWAGE ON GERMAN RIVERS.

BY K. DIETZE.*

It is about forty years since the needs of the high-running tide of German commerce began to direct renewed attention to the possibility of making use of the inland waters as traffic ways. The want of suitable means of transport, especially for cargo, made itself the more felt because the railways had not then developed to their present high state of efficiency. Even in the face of this powerful rivalry a large share of the transport of goods still falls to the cargo vessels on the rivers and canals, and will probably continue to do so for all time, in Germany as well as in other countries, because, on account of their low original purchase, maintenance and working costs, and therefore of the small amount of the interest on and amortization of their working plant, they can work at much cheaper rates of freight than the railways. In the case of bulk goods, for which rapidity of transport is less required, this latter circumstance is of great importance.

By reason of the low state of the water occasionally experienced in most of the rivers of Germany, the conditions there are, it is true, no longer so favorable for inland shipping as they formerly were, so that the competition of the railways has gradually become very formidable. Moreover, this occasional shallowness of the German rivers admits only of a partial use of cargo steamers, a peculiarity of which is that, apart from their high original purchase and maintenance costs, a considerable part of their otherwise available space and carrying capacity has to be surrendered to the accommodation of engines, boilers and bunkers. Also, in view of the in part very considerable fall of the rivers, and of the consequent speeds of the currents during high stages of the water, power would have to be amply apportioned to such vessels to enable them to make fair headway in the up-stream direction. The result of this state of things was the retention of the old-fashioned engineless cargo barges fitted, for occasional use only, with from one to three large sprit sails. It now, however, became urgently necessary to provide for their up-stream journeys special tugs, which should be capable of propelling themselves and the barges on these shallow waters even against a strong current. Thanks to the very extensive regulation of the courses of the rivers, shallow-going side or stern-wheel paddle steamers, which, with draft of about 2 feet, can carry engines of as much as 350 indicated horsepower, are generally made use of with advantage. Not many decades ago, however, when jutting promontories of the banks or narrow bridges severely throttled the current, and rapids rendered up-stream voyages difficult, the so-called Tauerei, or mechanical towage, was in full bloom on the German rivers. The term Tauer, or towing vessel, was applied to all river steam tugs which by means of mechanically-operated drum or wheel appliances wound themselves and their trains of barges along a rope or chain that was permanently anchored in the river.

It will at once be apparent that the advantage of this method of towage over that with paddle or screw lies in the avoidance of the slip. The slip of the paddle or of the screw must, in view of the opposing speeds of current and small depths of the water, make itself specially unpleasantly felt when, in addition, the propeller is burdened with the considerable resistance of the train. This consideration will at once show that, where the last-named influences (fast-flowing currents and small depths of water) are especially operative, paddle or screw steamers will work very uneconomically, whereas the Tauer will move forward with the speed due to the revolutions of its machinery uninfluenced by the speed and depth of the current. The propulsive efficiency of the Tauer is here

*Charlottenburg-Berlin.

TABLE 1.

			Paddle Tugs.			Rope-Towing Vessels.		
1	Name of vessel		Cöln I.	Cöln II.	Mannheim.	No. I.	No. III.	No. V. (Tauer).
2	Towed Vessels	Wooden barges...number	4	5	2	6	5	5
3		Iron barges...number	1	0	1	0	0	0
4		Cargo-carrying capacity...centner*	25,170	24,456	0	25,271	26,445	25,197
5		Cargo...centner*	25,170	23,593	19,600	19,060	25,723	22,552
6	Length of the chain-towing stretch...km.		82.98	82.98	91.5	57.78	22.24	13.65
7	Net time of running...hrs. m.		18 h. 4 m.	16 h. 59 m.	21 h. 10 m.	13 h. 57½ m.	4 h. 29 m.	3 h. 5 m.
8	Speed over the ground...m. sec.		1.248	1.357	1.20	1.15	1.378	1.23
9	Speed over the ground...km.-hr.		4.493	4.884	4.33	4.14	4.96	4.43
10	Engine power...I.H.P.		803	753	450	131	145.1	133
11	Consumption of coal per I.H.P. per hour...kg.		1.142	1.105	1.62	1.45	1.42	1.46
12	Speed of current...km.-hr.		1.65	1.40	1.65	1.50	1.40	1.47
18	Speed against the current...m.-sec.		2.898	2.757	2.85	2.65	2.778	2.70
19	Average resistance of the towed train...kg.		7,309	6,713	4,699	5,981	5,528	5,677

* 1 centner equals 50 kilogrammes.

affected only by the ordinary resistances in the engine itself, and by losses in connection with the gearing and drums (given by Arntzen at 23 to 25 percent for ropes); further, there is a certain loss of efficiency due to the raising and stretching of rope or chain or to slipping (about 3 percent for ropes according to Arntzen, about 10 percent according to Bellingrath). For chains the latter assumes a total efficiency of .7 × .87 (these being inclined from 8 to 10 degrees from the horizontal with an engine of 120 indicated horsepower, a speed of vessel over the ground of 5 feet per second, and a weight of chain of 10 pounds per foot of length). On the other hand, in addition to the ordinary losses in the engine, screws and paddles are further subject to vertical thrust and water-raising losses and to their frictional, form and eddy resistances, so that a towing vessel of this class may be credited with an efficiency hardly exceeding about 30 percent. For the institution of a comparison between the working capabilities or rope Tauers and paddle tugs, Prof. Teichmann (1880) gives the figures in Table 1.

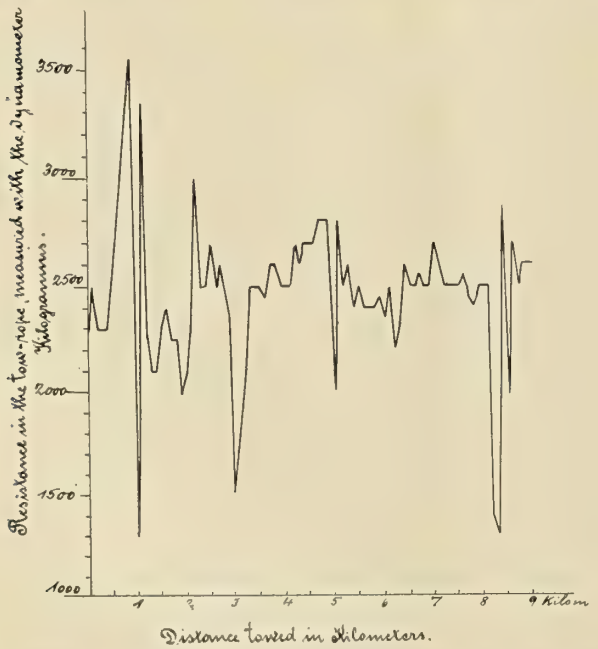


FIG. 1.—TOW-ROPE RESISTANCE OF A RHINE BARGE (OF 1,670 TONS CARGO CARRYING CAPACITY AT A DRAFT OF 8.85 FEET) LOADED WITH 1,030 TONS OF CARGO AT A DRAFT OF 6.3 FEET, TOWED UPSTREAM BY A PADDLE TUG ON THE SIX-MILE REACH BETWEEN LEINERSHEIM AND WÖRTH.

The resistances of the barge train that here come in question vary very considerably with the attendant circumstances. It is in such cases advisable first to institute on the special experimental trials for the type of barge found on a particular river in question on the reach on which it is intended to ply. Account must here be taken of the experience that, in contrast to the conditions with a Tauer, a barge behind a paddle or screw-steamer has its resistance increased on the average by 10 percent. It is, moreover, a well-known fact that the bargemen much prefer to have their vessels drawn along behind a Tauer than behind a paddle or screw-vessel which churns and tosses the water about, quite apart from the consideration that the section of the river may be damaged by the waves raised by a tug-steamer of one of these types.

The following illustration (Fig. 1) shows within what wide limits the resistance of the barge trains may vary. It must not here be forgotten that the resistance of wooden cargo barges is about 50 to 75 percent greater than that of iron ones of the same size. The fitting of a wooden bottom in an iron vessel alone suffices (according to Haack and Engels) to increase the resistance by an average of 33 percent. On the other hand, it is not advantageous to reduce the resistance of the tug itself too much by reducing her coefficient of displacement or by other means of this kind. Blümcke (see the papers of the Permanent International Association of Navigation Congresses) very appropriately compares the required minimum displacement with the minimum weight which a locomotive must have in order to give the necessary rail friction for heavy work. The degree of efficiency found by experience to be necessary for a chain-towing vessel may be obtained from the following considerations:

If W = the total resistance of the tug with its train,
n = the number of towed vessels, not including the tug,
K = about .3 = coefficient of resistance, and
F = area of 'midship section of one of the towed vessels in square meters,
K_1 = about .4 = coefficient of resistance, and F_1 = area of 'midship section of the tug in square meters,
v = the speed of the tug over the ground in meters per second,
c = the speed of the current in meters per second,
N_t = the total efficiency of the installation,
g = the acceleration of gravity in $^m/_{sec^2}$,

then $\frac{W\,v}{75} = N_t \times I.\,H.\,P.$

$$W = \left(\frac{n+1}{2} \times K \times F + K_1 \times F_1\right) \frac{1{,}000}{2g} (v+c)^2,$$

and therefore

$$\left(\frac{n+1}{2} \times K \times F + K_1 \times F_1\right) \times \frac{1{,}000}{2g} \times (v+c)^2 \times v = N_t \times I.\,H.\,P. \times 75.$$

Thanks to the very economical use of the horsepower just set forth the costs of working are relatively small. For instance, the coal consumption of a chain tug on the Elbe is only one-third that of a paddle tug, and that of a rope tug on the Rhine only $\frac{1}{3.6667}$ of the latter for the up-stream journey. On the down-stream journey the difference, of course, becomes less. An additional advantage is to be found in the reduced number and wages of crew required and in the relatively small expenses of maintenance and repairs.

Bellingrath, the staunch upholder of the German chain-tug traffic, writes off 6 percent of the first cost of the chain vessels (exclusive of equipment) and 7 percent for the chains. He assumes the annual cost of the repairs of a chain vessel of about 130 feet in length with engines of 130 indicated horsepower to be about $1,200 (£240). Judging by the balance sheets of the chain traffic companies, these figures would appear to be somewhat too low. In 1880, for instance, we find 12½ percent written off by a lower Elbe company for the chain and about twice as much for repairs to a chain tug approximately corresponding with the above in size.

It is true the chain and rope towage systems also have many disadvantages. The heavy first cost will only admit of the use of a single line of chain or rope for up-stream and down-stream work, so that when two vessels meet their passage becomes a difficult and complicated matter. This operation has been somewhat simplified by the fitting of a special propelling plant for the down-stream journey. But during work the small degree of mobility and the constant dependence on the length and position of the chain or rope form a not inconsiderable impediment to the rest of the river traffic. This is, moreover, especially the case when the chain or rope breaks, so that a whole train of barges lies helpless in the channel. Further, the permanent installation of such a valuable object as the chain or rope on the bed of the river, where it is exposed to the action of drifting ice and to decay in various ways, and where it is also difficult to look after, has its objections. It once happened on the Elbe that a trunk of a tree was caught by the chain in such a way that one of its ends stuck in the ground and the other penetrated the skin of the vessel, which then sank. Again, on the down-stream journey, screw and paddle tugs give greater security in the towage of barges so that they can take the same number of these as on the up journey. Moreover, a screw or paddle steamer may be applied to other purposes, or may be sold, whereas this would be very difficult in the case of a chain or rope vessel. Finally, the introduction of the chain and rope systems meets with difficulties on rivers the courses of which are interrupted at frequent intervals by dams or locks.

The question whether the chain or the rope system is the more advantageous was the subject of somewhat extensive discussion about forty years ago in Germany. A fact it is, that in view of the considerable practical success attained with the chains, which were the first to be introduced into Germany, they for a considerable time held their ground. Towards the close of the seventies, however, a powerful competitor arose in the flexible steel wire rope. The deciding factor in the question whether rope or chain shall be resorted to is the available depth of water on the reach in which the vessels are to ply. Thus on the Rhine, with its ample supply of water, we find the rope system (average depth of water on the reach in question equals 3.28 feet), while on the shallower tributaries of the same river and on the Elbe (average depth of water 1.6 to 2.6 feet) the chain system is the one in use. The point of importance in shallow waters is not so much the strength as the weight of the appliance. In shallow water a rope would, by reason of its small weight, have to be raised from the ground for too great a distance, and this would be especially awkward at sharp bends of the river or in cases of meeting with other vessels. On the other hand, however, a chain may in such case be sufficiently depended upon to afford the necessary friction on the river bed against the pull of the vessel and against lateral shifting. The chain also, when raised by the vessel, drops into the water again more easily than the rope, on account of its much greater mobility; for the same reason its application admits of the use of comparatively smaller and lighter wheels, rollers and drums. The chain is also less easily affected by local stresses, so that, even at the lowest state of the water and with moderate ice drift, the service can be maintained. Further, the breaking of a chain can, by the interposition of a shackle, be more easily repaired, and shortening or lengthening may be more readily effected than in the case of a wire rope. The winding drum for a chain is also to a certain extent simpler in itself and in its fittings, the chief advantages being the leading of the chain along the center line of the vessel with the attendant symmetrical arrangement of the weights on board and the considerably improved steering.

On account of the readiness with which disconnecting can be effected the tug can use the same chain also on the down-

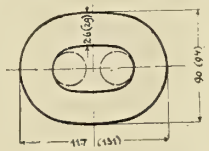


FIG. 2.

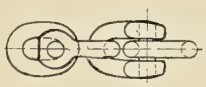


FIG. 3.

FIG. 4.

stream journey. The parting of the chain to enable an approaching train of vessels to pass, which will be described later, renders the provision of a separate propulsive arrangement for the down-stream journey unnecessary.

According to information kindly supplied by the "Vereinigte Elbe-Schiffahrts-Gesellschaft, Dresden," which still carries on the chain towing service on the upper Elbe and Saale, the links of the chains used in these rivers have the dimensions given in Fig. 2, the figures in parenthesis applying to the Bohemian reach of the Elbe, which has a somewhat greater fall than the others. The chain is manufactured in lengths of from 1,640 to 3,280 feet, and the connections are made by means of chain locks, or double shackles, which take the form shown in Fig. 3. Similar chain locks are kept in readiness on the steamers, and, if the chain happens to break, are used for reconnecting. The diameter of link of the chain that is still in use on the Neckar towing service is 1 inch, and its first cost, including laying, on the 79-mile towing reach are stated to have amounted to $120,000 (£24,000).

The life of a good chain of about 1 inch in diameter of link on a difficult river reach ranges from about four to at most six years when used from three to five times a day by tugs. After this, however, it can still be used for several years on reaches on which the general conditions and the stresses are less severe. The chain on the Elbe is anchored at each end.

In spite of the undoubtedly great advantages of the chain, it also has serious disadvantages. Its great weight limits the steering capabilities of the tug and of its train, and the ability of these to deviate from the line of advance to a considerably greater degree than in rope towage. By reason of its great weight and of its structure, the chain also wears away much more rapidly than the rope, and also wears out the drums and wheels, this action being further increased by the sand and dirt from the river bed which adheres to it, and by its twisting and frequent entanglement. In addition the chain causes severe vibration of the whole structure of the vessel and makes a good deal of noise in passing over the drums and

wheels. The first cost of a wire rope, moreover, is only about one-fifth of that of a chain, and therefore is associated with relatively smaller interest and amortization. The chain, then, when separate lines are provided for the up-stream and down-stream journeys, will be economical only in case of very great traffic. High stages of the water will oblige the chain vessels to cease work sooner than the rope vessels. For the considerably increased weight of the lifted chain acts very unfavorably on the stability of the tug, especially when the pull is partly lateral. A case actually occurred on the Neckar during a somewhat high state of the water, in which, probably from the cause referred to, a chain-tug was blown out of her course by a lateral gust of wind and caused to capsize. Then, again, a wire rope, by reason of the uniform stressing of all its strands, gives greater security against breaking, and a broken chain always causes unpleasant disturbance of work, loss of time and expense, not to mention direct danger, to the crew and to the rest of the traffic. This advantage of the rope is unquestionably to be attributed also to its smoothness of working and to the possibilities it gives of exact manufacture and testing, all this at the same time considerably reducing the annual outlay for repairs.

The wire ropes for the tug-steamers on the Rhine are made up of seven strands of seven wires each of Siemens-Martin steel; the whole rope has a diameter of 1.7 inches and a weight per foot of 5 pounds. The center strand is enclosed in a waterproof covering, and the splicing of the ends is performed with especial care. The life of a rope is found by experience to be from five to six years.

The structure of another rope, which has been supplied for a wire-rope towing vessel on the very dangerous Iron Gate reach of the Danube, may be seen from Fig. 4. This rope has been armored by a covering of special Z-shaped external wires to protect it from the very sharp rocks and stones, with the incidental effect that wear and tear has been reduced, and that any catching of the rope on projecting points and corners is prevented. Within the armoring come two layers of flat-sided ring-segment-shaped wire, and the necessary flexibility is obtained by the 12 + 6 round inner wires. As a result of its structure, every rope has the tendency, in a greater degree than a chain, to twist about its longitudinal axis. In view of this a swivel arrangement was in the first instance attached to a block of stone in the river bed, to which in the above-mentioned case the rope was anchored, ball bearings being used in order to still further reduce the resistance to twisting.

After the foregoing observations on the principal members of the towing installation we may return to the vessels. The first chain was experimentally installed on a reach of the Elbe between Magdeburg-Neustadt and Buckau (about 3.4 miles in length) in 1866, and a chain-tug was set to work to tow laden and unladen vessels cheaply and safely up-stream through the Magdeburg bridges, where a strong current runs. The favorable results thereby achieved encouraged the promoters of the undertaking to extend the chain towage service from Magdeburg to Hamburg on the lower Elbe in the one direction and to the boundary between Saxony and Bohemia on the other; it was subsequently continued onwards far into the latter country. On other rivers also the system was taken up. In 1891 we find it introduced on the following reaches:

		Miles.
1. On the Elbe—Melnik in Bohemia to German frontier.		68
Frontier to Magdeburg.....	(about)	200
Magdeburg to Hamburg.....	"	185
2. On the Saale—Barby to Halle.....	"	65
3. On the Brahe—Mouth to Bromberg.....	"	10
4. On the Neckar—Mannheim to Lauffen.....	"	80
5. On the Main—Offenbach to Aschaffenburg....	"	56
Aschaffenburg to Kitzingen....	"	125
6. On the Havel and Spree—Round Berlin.....	"	12

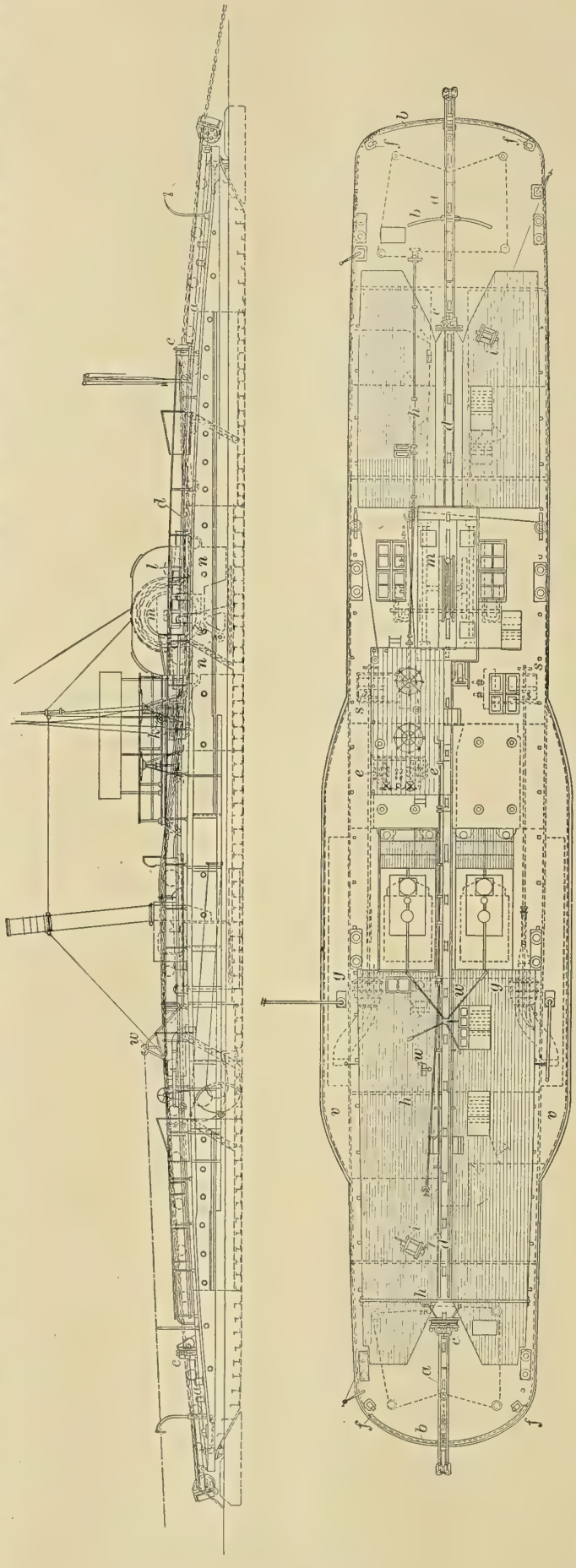


FIG. 5.—THE CHAIN-TOWING STEAMER.

On account of the year-by-year advancing regulation and canalization of the rivers and the accompanying reduction of the speeds of the currents, the chain steamers were, however, obliged one after another to give way to the superiority of the paddle tugs; at the present time the chain-towing services are retained only on the upper Elbe, the Saale, the Neckar and the Main.

The dimensions of the chain steamers of the "Vereinigte Elbe-Schiffahrts-Gesellschaften, A. G., Dresden," which now carry on the service on the Elbe and Saale are the following:

Length over deck, 125 to 183 feet.
Breadth, molded, 22 to 27 feet.
Depth, molded, amidships, 6.6 to 8.5 feet.
Draft without bunker coal, 2 to 2.9 feet.
Number of boilers, 1 to 2.
Heating surface, 880 to 970 square feet.
Indicated horsepower, 100 to 200.

In view of the circumstance that the steamers in moving up and down stream are connected in the same manner in each case with the chain, their longitudinal section is made symmetrical (Fig. 5), so that the alteration of their direction of motion is effected by the reversing of the engines alone. Following the inclinations of the incoming and outgoing chain, the deck slopes down at each end to about 40 inches below the 'midship height. In order to increase the maneuvering power of the vessel she is provided with a rudder at each end, which can be separately actuated from the bridge by means of shafting, *h-v* (see Fig. 5). The later steamers are built entirely of steel, while some of the older ones have wooden bottoms. The engine and boiler rooms are arranged amidships, the crew space and other rooms being at the ends of the vessels. Forward and aft on the deck of a chain vessel is fitted an outrigger, *a*, the length of which is about one-sixth that of the vessel, and which is hinged in vertical rollers, *c*, and turned on one or more semi-circular racers, *b*. In conjunction with chain troughs, *d*, which, to facilitate the leading of the chain, are provided with vertical and horizontal rollers, the outriggers serve to lead the chain to the drums. The rollers are of cast steel or case-hardened cast iron; the non-movable chain trough, which at the same time serves to take the rollers, is made of plates and angles riveted together. To enable the chain to be brought back to its proper position in the channel in the case of sharp bends of the river the after outriggers are so arranged that they can, by means of special hand winches, be turned to a considerable angle in the lateral direction; spring buffers, *f*, limit the lateral movements of the outriggers. On each of the older vessels two chain drums, *a* (Fig. 6), which are driven by the engines below deck, and each of which is arranged to take three turns of the chain, are installed at about the middle of the vessel. By means of two disconnectable systems of wheel gearing with different reduction ratios, different speeds of drum or of advance of the vessel can be applied for the up-stream and down-stream journeys, respectively, without any alteration of the revolutions of the engine, which it has not been found desirable to vary to the otherwise necessary extent. Each of these chain drums consists of four single wheels with steel tire bands, which are separated by wrought iron disks, which project so as to form flanges. By this means grooves are formed, which take the chain, the latter being prevented from slipping entirely by its friction against the periphery of the drum. The fitting of two drums was necessary because it was impossible with a single one to get the chain to wind itself evenly onto the one side of the drum and from off the other side without lateral slipping. The flexibility of the chain renders possible the use of relatively small wheels and drums, and this again admits of lighter construction of the winch and of the leads along the vessel. The circumference of the drum over the tires is about 11.5 feet, corresponding with a diameter of 3.6 feet. The distance between the axes of the drums is about 8.2 feet, and the reduction ratio of the drum to the engine is about from 2 to 1 to 2.5 to 1.

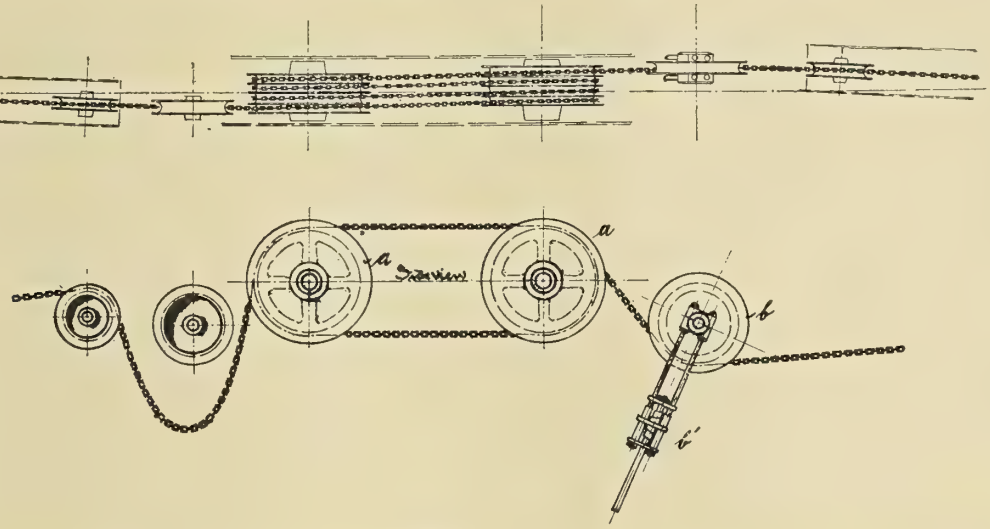


FIG. 6.

Now it is clear that on account of the maximum stresses which there occur the outer grooves of the chain drums are specially subject to wear. The result of this is that their diameter becomes smaller, so that the central grooves have a tendency to wind on more chain than the outer ones. By reason of the lengthening of the chain at this turn on the drum, even when no twists nor kinks have to be reckoned with, stresses of such magnitude have been set up that most of the breaks that have occurred could be clearly traced to their influence. Here, again, our thanks are due to Bellingrath, whose chain-grip wheel (D. R. P., No. 67,813, Fig. 7, and also *m* in Fig. 5) avoids all the disadvantages of the old chain drums. This chain-grip wheel has in consequence lately been applied to all the German chain vessels. The arrangement consists in a single driving wheel, over the upper half of which the chain is led. In other respects the manner of leading the chain to and from the wheel is the same as before. The grooved driving wheel, *a* (see Fig. 7), has flanges, *b*, through which the fingers, *c*, from four to five of which combine to form a hand, *e*, are made to project on each side. The fingers,

which are provided with springs, *d*, that press them against the links of the chain, are fixed within the hands, *e*. By means of the rollers, *f*, these latter are forced to move in a separate guiding frame, *g*, in such a manner that during the passage of the chain the fingers are successively inserted between its links and prevent these from slipping. At the point where the chain leaves the wheel the hands with their fingers are, by means of guiding frames, *g*, corresponding with those which effect the grasp, set free again (see Fig. 7). The excessive wear which was expected to be set up by reason of the many moving parts has not taken place. The experiences obtained with the appliance are of the best, and the chain itself has suffered much less than by the old method.

With a view to the avoidance of the several turns of the chain round the drum, de Bovet proposed a single wheel, on the upper periphery of which the friction of the chain was to be increased by electro-magnetic adhesion. Experience is said to have shown that a partial turn of 270 degrees is sufficient

towing hawsers, *e*, the windlasses, *i*, and the funnel winches, *k* (Fig. 5), are arranged on deck. A separate towing apparatus, *w*, is provided for the down-stream journey.

On several of the chain tugs the experiment has been tried of fitting each of them with a pair of four-bladed screws with separate compound engine for the down-stream journey; but this principle has not found universal acceptance. On the newer vessels the screws are replaced by Zeuner turbine propellers (*g* in Fig. 5), which are stated to have given satisfactory results.

For those chain tugs, however, which negotiate the up-stream and down-stream journeys with the same chain, special measures are adopted to enable vessels to pass each other. Although it would be possible for a steamer *A* proceeding with her train in the up-stream direction to transfer her barges to a steamer *B* approaching from above, another method which is considered to cause less loss of time is preferred. During the passage of *A*, *B* is disconnected from the chain. To effect

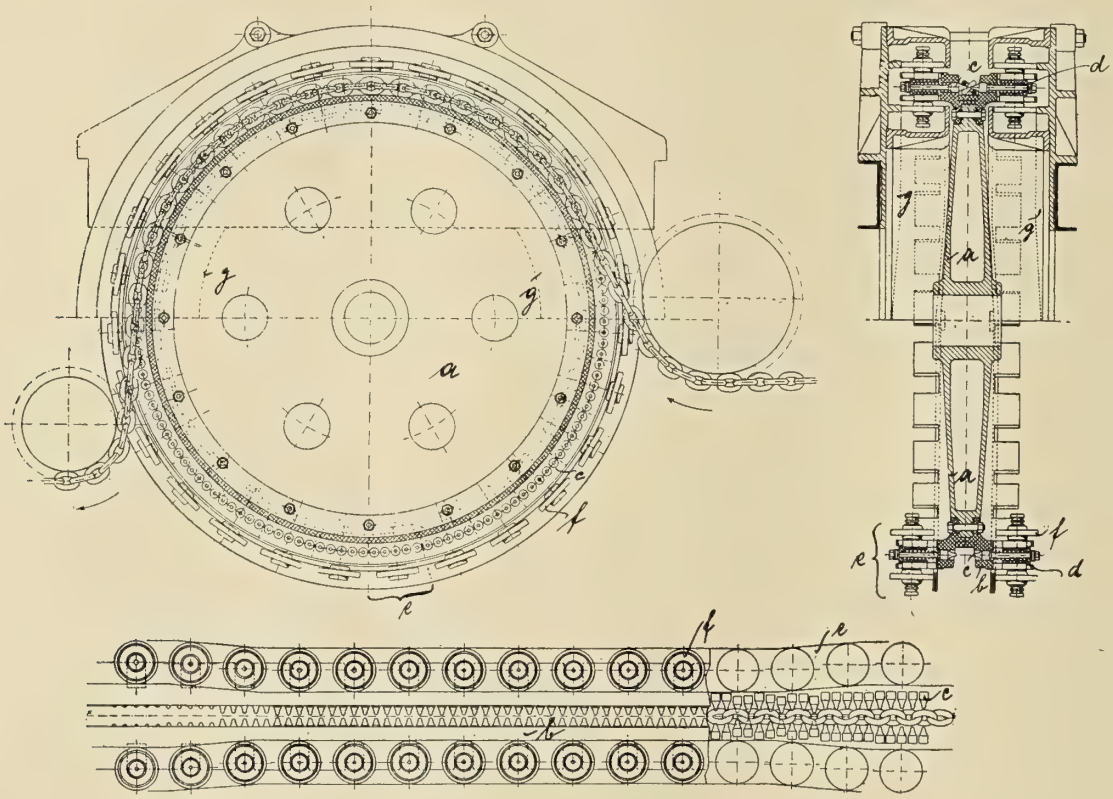


FIG. 7.

even in presence of moisture and dirt. Both chain and wheel are undoubtedly saved from wear by this means. It appears doubtful, however, whether it would be equally effective in case of violent twisting of the chain.

The engines used in the older vessels for the driving of the drums or gripping wheels are of the twin-cylinder description, with jet condensation. (Diameter of cylinders about 15.4 inches, stroke 27 inches and revolutions per minute 50.) Recently four-cylinder compound engines with jet or surface condensation have been substituted. The Woolf engine for the winding gear of the steamer *Baensch* (Fig. 5) has cylinders of 9.85 and 17.6 inches in diameter with a stroke of 11.8 inches. The newer vessels have the low-pressure cylinder with its rod at the one side of the winding gear and the high-pressure cylinder at the other. The boilers are of the single-ended marine description, with one or two furnaces on the return-flame or on the direct-flame plan. Their working pressure is 60 to 150 pounds per square inch.

Separate auxiliary engines for paying out and hauling in the

this *B* looks for a chain lock and opens it at a point on her deck opposite to the down-stream outrigger. A rope is attached to each of the loose chain ends, and the vessel makes her way slowly down stream. When the rope attached to the up-stream chain end has reached the drum of *B*, it is replaced by an auxiliary chain *C*, which is then attached to the main chain. During a further advance down stream this auxiliary chain is wound over the drum in place of the main towing chain, and drawn along the fore chain trough up to a point in way of the up-stream outrigger. The lower main chain end has meanwhile been lowered onto the river bed by means of the attached rope, and since the vessel has moved down stream it also comes into the vicinity of the up-stream outrigger of *B*. Here the loose end of the main chain is raised by means of the rope and again connected with its other end on tug *B* by means of the original chain lock, after the up-stream end has been taken out of the outrigger, so that the main chain again forms an unbroken whole. The auxiliary chain *C* is now disconnected from the main chain again after the tug *B* has attached

herself to the latter by means of another small chain *D*. On a preconcerted signal the up-stream moving tug *A* with her train comes nearer, till she lies alongside the tug *B*, which now attaches herself to the tug *A*. The latter continuing to move up-stream, *B* is taken along till the small auxiliary chain *D* can be detached from the main chain. The two tugs, thus coupled together, continue their advance up-stream until the chain lock already made use of comes out behind the down-stream outrigger of the tug *A*. Here the lock is again opened, and the down-stream chain end, to which a small line has been attached, is taken over to the tug *B*, through her after outrigger, and made fast there by means of a chain catcher. Tug *B* is now cast loose from *A*, and drifts back till her up-stream outrigger is opposite the down-stream outrigger of *A*. The chain *C*, which is still on the drum of *B*, is again passed through the down-stream outrigger rollers of the tug *A* and connected with the main chain end, which is still lying there loose. The two steamers now move one behind the other up-stream. *A* is free to continue her journey up-stream, and *B* follows her until first the chain *C* and then the main chain has passed the drum of *B*. Chain *C* is then removed again, and the loose main chain end, being drawn by means of the attached line through the fore outrigger and through the chain trough, the ends of the main chain are connected together again with the original chain lock. Steamer *B*, also, is now enabled to continue her down-stream journey.

The passing of two steamers in this way occupies a time of from fifteen to thirty minutes, while the transference of the train of barges to the approaching tug *B* would take twice as long.

In case of the breaking of a chain the engines are at once stopped by the shutting off of the steam supply by means of a weight, which, when the engine races, is released by a governor with four fly-balls on the attainment of a certain number of revolutions. The anchors must then be let go to prevent the train from drifting away or the barges from colliding with each other or with the tug. When the chain fracture occurs on the steamer herself the running out of the towing chain is prevented by chain catchers fitted for the purpose. On the insertion of a chain lock (see Fig. 3), which is accomplished in about fifteen minutes, the journey can be continued. If, however, the chain fracture occurs in open water ahead of her, a steamer that is provided with apparatus for self-propulsion will, after anchoring the train of barges, attempt to pick up the lost chain-end by means of a small search-anchor. A steamer not so provided must conduct these operations from her boat. By means of a small auxiliary chain the loose end is then drawn through the outrigger onto the vessel till the two ends meet; they are then connected together by a spare chain lock held in readiness for such occasions.

The up-stream journey on the Elbe with the chain is, on the average, accomplished at a speed of from 2.5 to 3.1 knots, and the down-stream journey at about 5.4 to 6.5 knots. The engine of the steamer develops about 130-180 indicated horsepower, and is so dimensioned that from 1,200 to 1,500 tons of cargo can be carried up-stream in from four to six towed barges.

On the older vessels the coal consumption was about 7.7 pounds of lignite per indicated horsepower, but on the introduction of the compound engine this was reduced to from 4 to 4.5 pounds per indicated horsepower per hour.

For the development of the chain-towing traffic on the rest of the rivers of Germany the experiences obtained on the Elbe have been in general followed. On the Neckar, seven chain tugs belonging to the "A. G. Schleppschiffahrt auf dem Neckar, Heilbronn," carry on the service. The particulars of these vessels are: Length, 147 feet; breadth, 21.3 feet, and displacement 112.5 tons at a draft of 1.75 feet. Their contract price was about $14,000 (£2,800) each, and the material and engine stores used are stated to cost about $400 (£80) a year. With engines of 110 to 130 indicated horsepower their maximum speed up-stream is 2.8 knots, and their maximum speed down-stream about 6.8 knots. The engines are of the high-pressure condensing type with an admission of .3. The average hourly consumption of coal is about 3.5 pounds per horsepower per hour. The working conditions on the Neckar are specially favorable for chain towing, because, owing to the peculiarities of the river, any competition from paddle or screw-tug steamers is impossible. As a result of this the financial result is a very good one. On the other rivers this is not everywhere the case.

(To be continued.)

A SINGLE-SCREW STEEL RIVER TUG.

Among European rivers the Rhine is the one which carries the heaviest traffic, and although some small sea-going ships ascend as far as Cologne, it is interesting to note that the river traffic between the seaport Rotterdam and the different points beyond the German frontier is carried on in a manner quite different from anything to be found elsewhere. The greatest part of the freight handled is iron or coal and other bulk cargo. The goods are trans-shipped in Rotterdam in so-called river lighters, the lighters coming alongside the sea-going ships for the cargo. The capacity of these lighters ranges from 300 to 3,600 tons deadweight, and all of them are towed to their destination by river tugs.

The tugs differ widely in size, construction and efficiency, but for regular long-distance work they run from 150 to 1,500 indicated horsepower. The larger ones, which are mostly paddle steamers, serve on the upper Rhine, principally between Duisburg and Mannheim, and even as far as Strassbourg when the depth of the water permits. The smaller tugs up to 600 indicated horsepower maintain the traffic between Rotterdam and Duisburg, although some of them go as far up the river as the biggest side-wheelers.

The tug illustrated is one of the latter class, which was designed and constructed by Messrs. Arnhemsche Stoomsleephelling Maatschappij in Arnheim, Netherlands. She was designed to draw a load of 1,500 tons in two lighters up stream from Rotterdam to Duisburg in forty-five hours, on a guaranteed coal consumption of 1.7 pounds per indicated horsepower-hour, using slightly superheated steam of about 250 degrees C., with her engines working at normal cut-off, making about 190 revolutions per minute, the firing to take place under natural draft.

The hull, constructed of mild steel, is 83 feet long between perpendiculars, 17 feet 6 inches breadth, molded, 18 feet 6 inches breadth over guards, 8 feet 5 inches depth, molded, 6 feet 3 inches draft with 35 tons of coal in the bunkers. Four watertight bulkheads divide the hull into five watertight compartments, the fore-and-aft peaks serving as water-ballast tanks. The captain's quarters are fitted forward, and the crew is berthed aft.

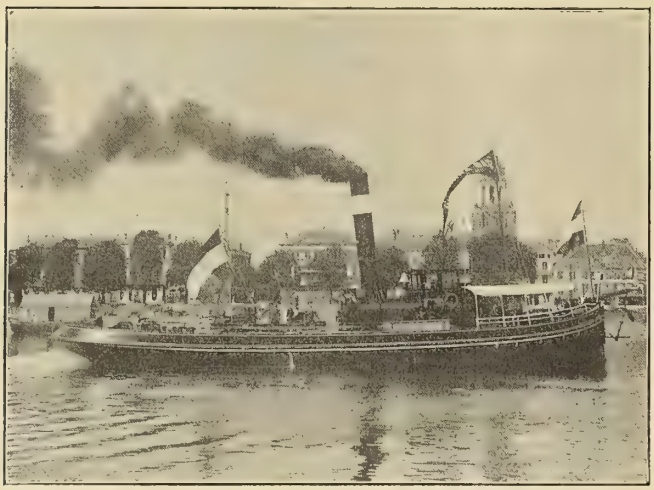
The machinery consists of a set of diagonal triple-expansion engines, fitted with a jet condenser and horizontal air pump, developing about 275 indicated horsepower with normal cut-off and running at 190 revolutions per minute, using steam at 205 pounds pressure superheated to 250 degrees Centigrade. This construction of engine is a specialty of this firm, which was patented in 1888, and of which a great number have been built, varying from 70 to 600 indicated horsepower, mostly for river work. The engine for this boat has cylinders 11 inches, 18 inches and 29½ inches diameter, with a common stroke of 14 inches. All three connecting rods work on a common crank-pin; all valves receive their motion from one common

eccentric strap, thus reducing the wearing parts as much as possible. The high-pressure cylinder is fitted with cut-off which can be varied from 56 percent, which is the normal up to 75 percent, which is the maximum. This arrangement is actuated by a small eccentric placed on the crankshaft between the forward main bearing and the eccentric governing the valve motion. It works on an ordinary double-bar link, which can be lifted or lowered, and gives the necessary changes in travel of the valve and cut-off. With this arrangement the engine can be forced to develop about 370 indicated horsepower at about 220 revolutions when working on the maximum cut-off. This is used at places where the current is exceptionally strong on the upper Rhine and in the rapids near Bingen.

The cylinders are of hard, close-grained cast iron cast in one piece, with the valve casings and with the necessary flanges for pipe connections. The high-pressure valve is a piston valve, the intermediate valve an ordinary D valve, and the low-pressure valve a double-ported slide valve.

The bed-plate and framing of the engine are of cast iron, secured to the engine seating in a rigid manner, as can be seen from the illustration. All the shafts, connecting rods, crossheads, eccentric straps and all rods and levers in connection with the air pump gear and valve motion are of the best forged steel.

The jet condenser is cast in one piece with the air pump, and is placed just behind the low-pressure cylinder. The air pump is of the horizontal type, double-acting, the rod being carried through the back cover, acting as the feed pump plunger. The bilge pump, which is of the ordinary single-acting horizontal type, is connected by the air pump eccentric, which is keyed onto the crankshaft just behind the main bearing. All bearings throughout the engine are of hard



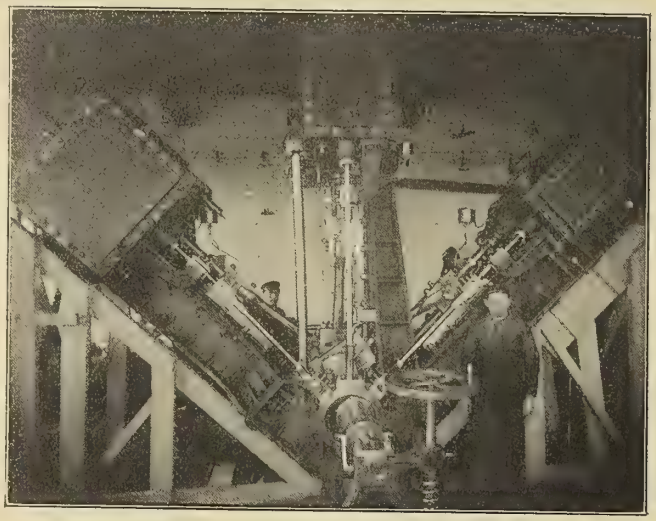
RHINE RIVER TUG.

gunmetal, and when transmitting a rotary movement they are lined with high-grade white metal. The thrust block is situated behind the engine on a rigid foundation.

Just above the air pump and thrust block an exhaust feed-water heater is placed, through which the exhaust is conducted before being condensed. The heating surface of the heater is about 90 square feet, giving a rise of temperature to the feed-water of about 15 degrees C.

Steam is supplied by a Scotch boiler of the river type, 11 feet long, 8 feet 9 inches diameter, with a heating surface of about 930 square feet. The boiler has a dome 16 inches diameter, 20 inches high, and all steam connections are taken from the dome through a heavy gunmetal T-piece. In the smoke-box is a steam superheater with a total heating surface of 330 square feet. The temperature, when working under ordinary circumstances, varies from 240 to 260 degrees C., and although not a high degree of superheat it gives an average of about 7 percent above saturated steam, without the drawbacks which come from superheated steam of very high temperature.

On trial the vessel used forty-three hours in running from



DIAGONAL TRIPLE-EXPANSION ENGINE FOR RIVER TUG.

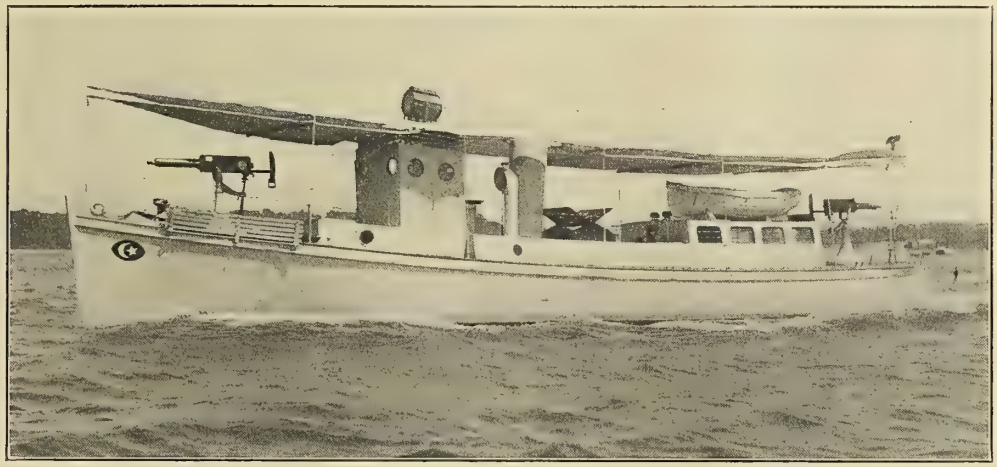
Rotterdam to Duisburg with a load of nearly 1,700 tons in two lighters, the coal consumption working out at 1.57 pounds per indicated horsepower-hour.

Compound Non-Condensing Machinery for a Light Side-Wheel Steamer.

A set of compound non-condensing machinery for a light side-wheel steamer, the hull of which has been built in Rangoon, but for which the design and working drawings were supplied by the makers of the machinery, has been built by Messrs. W. Sisson & Company, Ltd., Gloucester. The engines are of the makers' standard design, generally similar to the stern-wheel engines described elsewhere in this issue. The cylinders are 9 inches and 13½ inches diameter by 36 inches stroke, driving side paddle-wheels of the makers' specially designed feathering float type, which has an arrangement of grease lubrication to the joints. Since this vessel is to ply in the Rangoon River, the water of which is often sandy or dirty, this plan of grease lubrication, in conjunction with the easily removable and replaceable sleeves and bushes of the feathering gear, is a great advantage. The boiler is of Sisson watertube type, the working pressure being 165 pounds per square inch. A feed heater is provided, through which the exhaust steam from the engine is carried on its way to the blast nozzle in the base of the funnel, and a feed pump on the main engines delivers the water through this feed heater to the boiler. There is also an independent double-acting steam pump arranged with suitable connections for feeding the boiler or delivering water on deck for washing or fire extinguishing purposes. A third means of feeding the boiler in case of emergency consists of an automatic restarting injector. With this machinery a steam capstan of W. Sisson & Company's special design has also been supplied, there being two horizontal steam cylinders driving a vertical capstan head through worm gearing, but with special arrangement for hand working also. This machinery was supplied complete with all necessary accessories, also spare gear and outfit.

ARMORED MOTOR PATROL LAUNCHES FOR THE TURKISH GOVERNMENT.

No fewer than twenty-two armored motor patrol launches of the type illustrated have quite recently been constructed at the Woolston Works, Southampton, of John I. Thornycroft & Company, Ltd., to the order of the Imperial Ottoman government. These vessels are intended for service in the Red Sea, Persian Gulf and Mediterranean Sea, and will be used for the prevention of smuggling and kindred purposes. They have a length over all of 60 feet, a beam of 11 feet, and a depth of 5 feet 6 inches. The draft of water has been kept down to the minimum, being only 2 feet 6 inches, to render them capable of shallow river work. The lines have been designed to give the best results on a shallow draft, the flat stern giving easy running lines and keeping the stern from pulling down when going at full speed. The speed guaranteed as a mean of six runs on a recognized measured mile was 11 knots, and this speed had to be maintained for a further period of two hours.



TURKISH ARMORED MOTOR PATROL LAUNCH.

On official trial a speed of over 11.9 knots has been attained with engines not fully extended. All the boats yet tried have been capable of a knot over the contract speed. The boats have proved to be very handy, and can turn a complete circle of about a length and a half in diameter when running at full speed. Steering is effected by means of a hand-steering gear fitted in the wheel-house, and connected to the tiller on the rudder head by wire rope leads. Protection has been afforded to the steersman by constructing the wheel-house of bullet-proof nickel steel. The hulls are protected against rifle bullets by means of bullet-proof nickel steel fitted inside. This extends from the aft end of after cabin to forward end of the motor room and from the waterline to the deck. The casing sides also have been protected for the same length up to the height of the motor casing. The top of the motor casing is covered with nickel steel bullet proof at 60 degrees.

The arrangement of the boats is compact. The machinery is placed in a separate watertight compartment amidships, and is separated from the cabins, etc., by steel watertight bulkheads. The main fuel tanks are carried at the forward end of motor space in two circular brass tanks, the top one is used as a service tank and supplied to the motors under gravity. Two reserve tanks of brass are placed in the stern compartment, and connected to the forward tanks by means of a semi-rotary pump. The total fuel capacity is about 740 gallons of kerosene (paraffin), giving a range of over 600 knots at full speed. Abaft the machinery space a cabin for officers has been arranged, with a sofa-seat berth having cushion backs on each side of the cabin, and the seat backs arranged to hinge up to form top berths. The underside of the casing top has been lined with "Vanesta" wood in panels with air space to keep the cabin cool. Forward of the machinery space a cabin has been provided for the crew, with locker seats on each side to form lower berths and folding pipe berths with canvas bottom above. The boats are fitted with double canvas awnings, all fore and aft, carried on ridge wires and supported on wrought iron stanchions. Two guns have been fitted, one forward and one aft, of the Vickers Maxim patent 37 mm. quick-firing type, having water-cooled barrels. One thousand rounds of ammunition per boat are carried and stowed in lockers in the crew and officers' spaces.

The construction is practically similar to that adopted by the British Admiralty for their 50-foot and 56-foot pinnaces. The shell consists of two thicknesses of teak, the inner thickness laid diagonally and the outer fore and aft. The hull from keel to about 4 inches above the waterline is covered with 12-ounce copper sheathing. The keel is of oak, with a 1½-inch rubbing strip to take the wear. The boats have been built under the supervision of Lloyd's surveyors, and are equal to Class A in their yacht register for river service. The mild steel armor has been tested under British Admiralty supervision.

The main engines consist of two of the Thornycroft C/6 type, having six cylinders 6 inches bore by 8 inches stroke. At 750 revolutions per minute each engine will develop 70 horsepower, but in these boats the engines are kept back to 670 revolutions per minute by means of a spring-controlled governor. The fuel used is commercial kerosene (paraffin), which is vaporized in a Thornycroft vaporizer heated by the exhaust. Starting is effected on kerosene (paraffin) by heating the vaporizer with a blow-lamp, or if gasoline (petrol) is available by running on gasoline (petrol) for a few minutes. Ignition is by high-tension magneto. Lubrication is effected by means of the drip method, a pump pumping oil into a pipe over the cylinders, from which it runs through nipples to each main bearing and connecting rod. The pipe is provided with an overflow into the crankcase. This method of lubrication is at once sure, fool-proof and extremely economical in practice. Reversing is effected by means of an epicyclic reversing gear.

There is also an electric lighting set, consisting of a Thornycroft M. I. kerosene (paraffin) engine, having cylinders 4½ inches by 6 inches, connected to a Crompton four-pole direct-current dynamo, giving an output of 60 volts and 41 amperes at 800 revolutions per minute. This dynamo, which can also be driven by a belt off the main engine, is used to light the ship (ten electric lamps being provided), run three electric fans and

work the searchlight. The latter is of the Crompton type, with automatic and hand control, and has a projector 16 inches in diameter. Four of the boats were built in steel, and three others of the same power and of similar general arrangement, but of a still shallower draft (viz., 22 inches), are also of steel. The hulls were built complete at Messrs. Thornycroft's Woolston Works, Southampton, and as they were put into the water they received their motors, which were made at the Thornycroft Company's Motor Works, Basingstoke.

COMMERICAL MOTOR BOAT FOR CHINA.

The motor boat *Rosette* illustrated herewith is of the shallow-draft, tunnel-stern type, her principal dimensions being 45 feet long, 10 feet beam and 3 feet 6 inches depth. She has been designed by Messrs. R. Wilson & Sons, of South Shields, and built by Messrs. Banker & Company, of Hongkong and Wuchow, to the order of the British-American Tobacco Company in Hongkong.

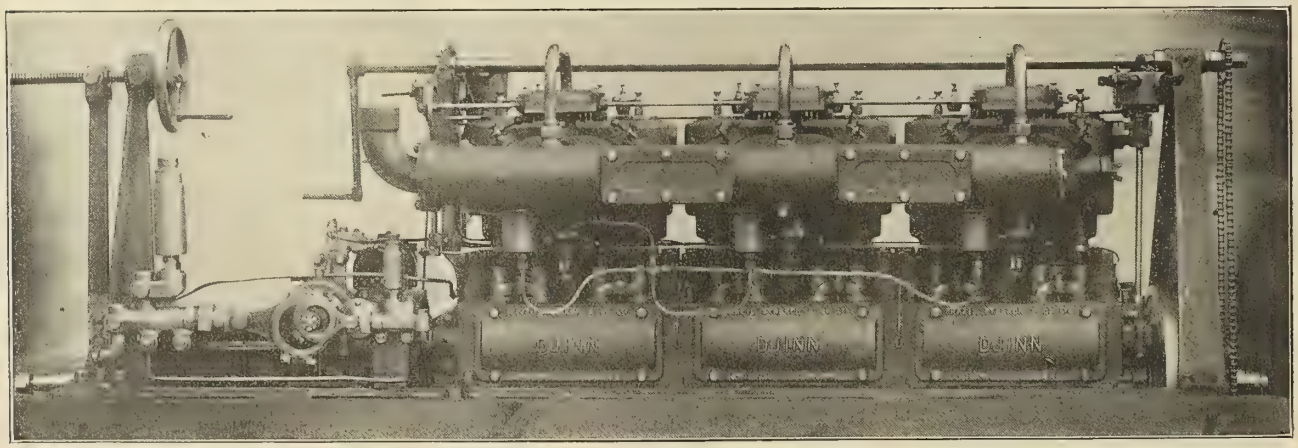
The boat will be run by a Chinese crew entirely, and in addition there will be two Europeans in charge of and to negotiate the sale of the cargo at the various river side villages, as the boat was designed and built exclusively for the sale of cigarettes at the various wayside villages on the Chinese West River and tributaries, her first run being one of 250 miles, and then 120 to 200 miles to the nearest supply base.

The hull is divided by watertight bulkheads into four compartments, the hold and engine room being amidships, and a large lazerette aft, fuel tanks and chain lockers being forward. The galleys and lavatories are arranged on the main deck aft, and the saloon and sleeping accommodation for the two Europeans on the upper deck. The steering wheel and telegraph are placed well forward on the upper deck and covered by an awning. To obtain all possible deck space a gangway is placed full length of the vessel each side.

CHINESE RIVER BOAT ROSETTE.

operate, but the engine is of the above firm's M. E. type, and runs entirely upon ordinary petroleum.

The engine cylinders are cast in pairs, and the bed-plate is one solid casting, upon which is mounted the whole engine and reversing gear (also the firm's own make), and the cylinders follow the firm's usual practice, being supported on steel columns, which method allows all stress to be taken up by the solid bed-plate. The engine details consist of Bosch high-tension magneto ignition with battery and coil as a standby, with bronze plunger pumps for fuel, circulating, forced lubrication and bilge. The fuel pump delivers to a small reservoir, which feeds the three float chambers, each pair of cylinders having its own vaporizing system. There are no induction pipes, as the fuel on being vaporized passes straight into the cylinders. This system is also noteworthy by virtue of the entire smokelessness of the exhaust. Accessibility is a prominent feature, the connecting rods and pistons being removable through the crankcase doors, while a few minutes are sufficient to remove the cam shaft and valve tappets. The valves, of course, are all on the starboard, so that the port side is free from gear. This is the standard practice on all Djinn engines.



SIX-CYLINDER, 45-HORSEPOWER DJINN PETROLEUM MOTOR INSTALLED ON THE ROSETTE.

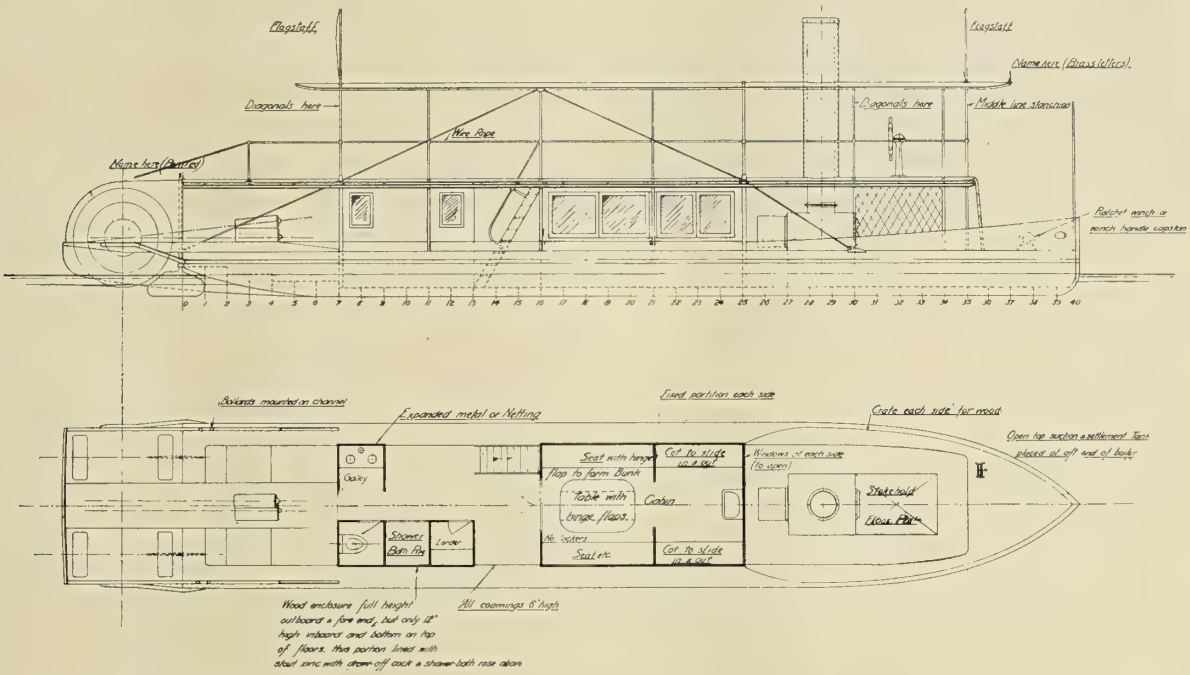
The machinery consists of a six-cylinder Djinn petroleum engine, built by Messrs. Brazil, Straker & Company, Ltd., of Bristol, developing 45 brake-horsepower at 800 revolutions per minute, giving a speed of 10 knots to the vessel when going "all out." This engine was built to the order of, and under the special survey of, Messrs. R. Wilson & Sons, and installed in Hongkong by Mr. R. Wilson, Jr., who ran the vessel from Hongkong to Canton (80 miles), making a non-stop run without any engine or navigation troubles. Generally, no gasoline (petrol) is obtainable in the district in which this vessel will

A water-cooled exhaust branch connects the exhaust outlet, and into this the cooling water is discharged, passing thence to the silencer.

The Hamburg-American Liner *Victoria Luise,* which was formerly the *Deutschland,* recently made her first trip to New York. Since remodeling the vessel's speed has been reduced to 17 knots, anti-rolling tanks installed, her passenger accommodations enlarged, and in future she will be used as a cruising steamship for extended cruises.

Stern-Wheel Steamer Grenfell for the Congo Mission Service of the Baptist Missionary Society.

This vessel is somewhat similar to the *Endeavor*, built for the Baptist Missionary Society for their Congo Mission service in 1905, and as illustrated in the November, 1910, issue of International Marine Engineering. It is, however, a smaller vessel, since it is to be used for pioneer work in the upper reaches and tributaries of the river, where the *Endeavor* cannot be navigated. The general arrangement is shown in the drawing. The length over all is 68 feet, between perpendiculars 60 feet, the molded beam is 11 feet, the molded depth 3 feet and the draft 1 foot 6 inches. The hull is of steel throughout, and all this, together with the sundry iron work, is galvanized. Special attention ought to be directed to the novel design of this hull. In order to secure strength and lightness the usual gunwale angle is dispensed with, and the sheer strake is curved and brought inboard to form the deck stringer. The stroke, and driving two separate paddle wheels, the crankshafts being coupled by a drag link. This design has substantial advantages over the usual type, being light, compact and less liable to interference or damage; the passage of steam from one cylinder to another is very direct and the drainage of the cylinders excellent. The arrangement of separate wheels and crankshafts secures flexibility, and therefore much less risk of injury if the hull is subjected to any special strain or distortion takes place. As will be noticed from the illustration the framing is comparatively light, and yet quite efficient owing to the special design, as it is triangulated in two planes and the materials employed are cast steel and malleable steel only. The connecting rod bodies are tubular for lightness; the steam distribution valves are both of the piston type, and the valve gear of the makers' specially designed single fixed eccentric or elliptic type. This gear has been exclusively adopted by them owing to the very satisfactory results obtained with it in actual work extending over a number of years. It


Flagstaff
Flagstaff
Diagonals here
Diagonals here
Middle line stanchion
Wire Rope
Ratchet winch or winch handle capstan
Expanded metal or Netting
Fixed partition each side
Crate each side for wood
Open top suction + settlement Tank placed at aft end of body
Seat with hinged flap to form Bunk
Cot to slide in & out
Windows (to open)
Table with hinged flaps
Cabin
Seat etc.
Cot to slide in & out
Wood enclosure full height outboard + fore end, but only 2" high inboard and bottom on top of floors. this portion lined with sheet zinc with drain off cock + shower bath rose above
All coamings 6" high

STERN-WHEEL STEAMER GRENFELL, BUILT FOR CONGO MISSION SERVICE.

maximum radius of the curved part is about 6 inches, and the coamings are placed where the curve runs out into the flat portion of the deck stringer, and this is shown in the plan view above. The trussing is of special design, having vertical tubular pillars which combine strength and lightness. The upper and shade decks are of teak, the former laid on two thicknesses breaking joint, and the latter covered with waterproof canvas. The cabin and conveniences are of teak, and arranged as suitably as possible for ventilation, as the climate is a hot and very trying one. The contract was placed by the society with W. Sisson & Company, Ltd., of Gloucester, who constructed the machinery, designed the hull and supplied the working drawings thereof to the builders, Messrs. Salter Bros., of Oxford. The vessel throughout was inspected during construction by the Rev. F. Longland, who came to England for this purpose and has since returned to the Congo, where he will supervise the reconstruction of the vessel and put it into active service.

The machinery is arranged on the middle line of the vessel, and consists of a set of the makers' specially designed compound non-condensing engines, having partially superposed cylinders 6½ inches and 10½ inches diameter by 30 inches gives an excellent steam distribution, the loads on the parts are light and the surfaces ample, so that the wear is exceedingly small, while there are no sliding working parts, but pin joints either bronze bushed or made with adjustable brasses, so that the adjustment is very simple. Owing to the light loads on the parts the handling of the engine is rendered very easy indeed.

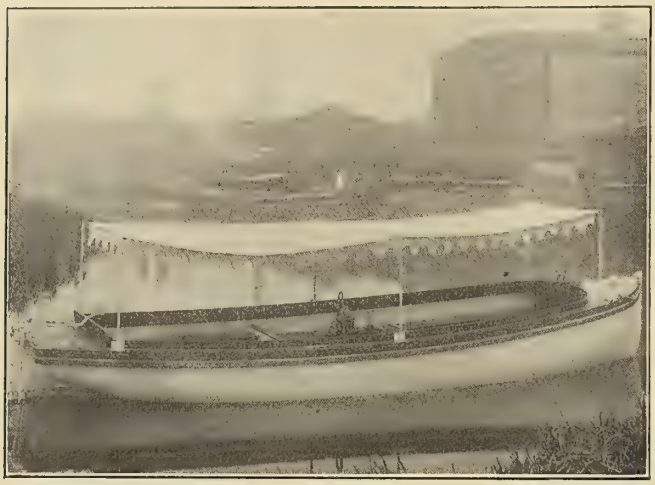
The paddle-wheels are of the makers improved light framed, feathering float type, with their patent system of grease lubrication applied to the working joints of the feathering gear.

The boiler is of the makers' special watertube type for 175 pounds working pressure, constructed throughout of best mild steel, the tubes being of seamless steel, all straight and of the same length. The steam drum is made specially large, so as to give ample steam space required for the long-stroke slow-running engine. The two water drums are formed of welded steel tubes pressed into a lune-shaped section, so that there are no longitudinal riveted joints. The steam drum is of sufficient diameter to admit of the tubes being inserted and both ends expanded from it. This design of watertube boiler has ample steam space, water capacity and free surface, so as to avoid priming, there being also no necessity for any automatic

feeding arrangement, while the grate area and furnace capacity are ample, thus enabling inferior fuel to be utilized. In the present case the furnace fittings are arranged for burning wood, this being the only fuel available.

Seamless Steel Shallow Draft Motor Launches.

A motor launch for commercial and general purposes in the Straits Settlements is manufactured by the Seamless Steel Boat Company, Ltd., Wakefield. The launch illustrated is 24



SHALLOW-DRAFT SEAMLESS STEEL LAUNCH.

feet long, 5 feet 6 inches beam and 2 feet 6 inches depth. The boat has a tunnel stern and is fitted with a two-cylinder 10-horsepower kerosene (paraffin) motor, which gives the boat a speed of 8½ miles an hour when loaded to a draft of 1 foot 2 inches.

STERN-WHEEL STEAMER FRANCESCO SALLES.

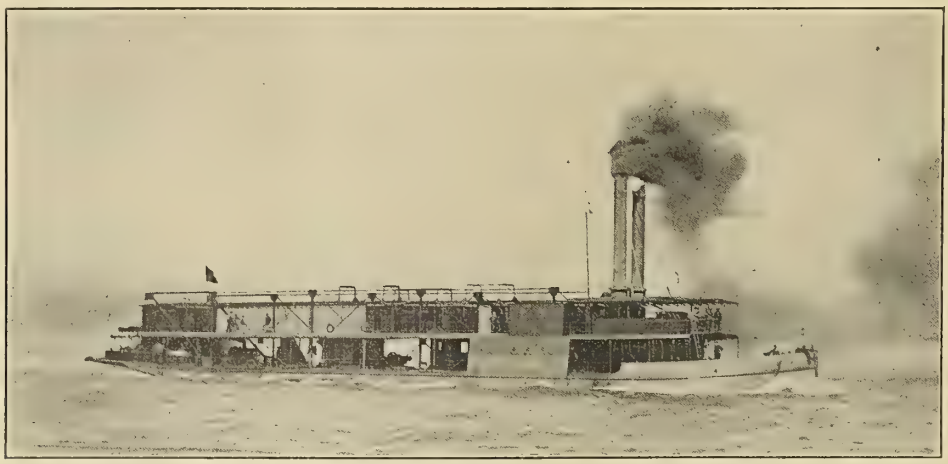
One of the large stern-wheel steamboats built last year in England was the *Francesco Salles*, built by Messrs. Cammell Laird & Company, Ltd., at their Birkenhead Works for the Madeira Mamore Railway Company of Paris, under the inspection of J. Ward, Esq., naval architect and consulting engineer for the railway company. The principal dimensions of the boat were as follows:

Length of hull	180 feet
Breadth, molded	33 feet
Depth to main deck	5 feet 6 inches

The hull is built of mild steel of the highest quality and subjected to Lloyd's tests, and is divided transversely by ten watertight bulkheads and longitudinally by one bulkhead extending from stem to stern, and in the way of the boilers by two extra longitudinal watertight bulkheads, thus forming in all eighteen watertight compartments, the bulkheads being specially arranged to stiffen the vessel against damage by striking floating logs, etc., and to minimize the danger of sinking. Nine of these compartments are suitable for carrying general cargo—four for coal or wood fuel, while the remainder act as store rooms and buoyancy chambers.

Sleeping accommodation has been provided in the promenade deck for fourteen first class passengers, arranged in two-berth cabins, and for the captain, pilots, mate and steward, while the engineers, boatswain, cook, seamen and firemen, etc., have spacious accommodation on the main deck. The principal deck-houses are of teak fitted with jalousie windows and doors, the tops being fitted with expanded metal, thus affording ample ventilation.

The dining accommodation consists of one long table with seats for about thirty-two persons, and one smaller table with seats for twelve persons, both arranged in convenient positions to the pantry and galley. The plumbing arrangements are very complete, having a system of steam bilge ejectors, each of about 20 tons capacity per hour, connected to the principal compartments, having a line of steel piping with gunmetal valves communicating between ejectors and boilers.



LARGE STERN-WHEEL STEAMER FRANCESCO SALLES.

The vessel is provided with a powerful combined steam and hand-capstan windlass, one large steam winch of Messrs. Clarke Chapman's make, combined steam and hand steering gear fitted forward of Messrs. Donkins' make, a complete installation of electric light on the double-wire system, and an outfit of anchors and chains, bollards, fairleads, mooring pipes, seamless steel boats, life belts and life buoys, oil lamps, compasses, bells, spanners, and everything necessary to complete the hull in a first-class manner.

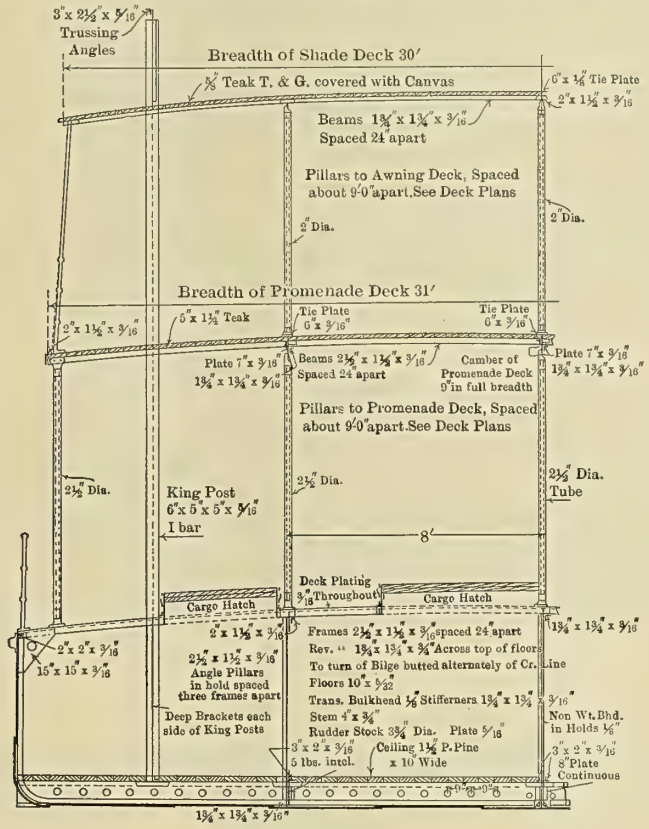
The machinery consists of a set of compound surface-

Shipbuilding Returns.

The Bureau of Navigation reports 92 sail and steam vessels of 23,282 gross tons were built in the United States and officially numbered during the month of September, of which nearly 80 percent was built on the Great Lakes. During the quarter ended Sept. 30, 350 sail and steam vessels of 56,217 gross tons were built, which is only about 60 percent of the tonnage built during the corresponding quarter last year.

Lloyd's Register of Shipping reports that, excluding warships, there were 493 vessels of 1,446,317 gross tons under construction in the United Kingdom at the close of the quarter ended Sept. 30, which exceeds by 292,000 tons the tonnage under construction during the corresponding quarter in 1910.

condensing engines, steam being supplied by two boilers, constructed for a working pressure of 150 pounds per square inch. The cylinders are 18 inches and 38 inches diameter by 5 feet stroke, made of hard close grained cast iron and fitted with flat type side valves; the pistons are of cast iron, having large bearing surface on lower edges and fitted with spring packing rings. The slide valve gear is of the locomotive type, with slot links bushed with phosphor bronze, the weigh shafts and levers being of forged steel. The condenser is of cast iron, having ample cooling surfaces and fitted with brass tubes and tube plates; the oil circulating and feed pumps are all of the independent type. The boilers are of the locomotive type, fitted with large furnaces, suitable for burning either coal or wood fuel, the heating surface being about 1,800 square feet; all the necessary manholes and mudholes are fitted for access, also

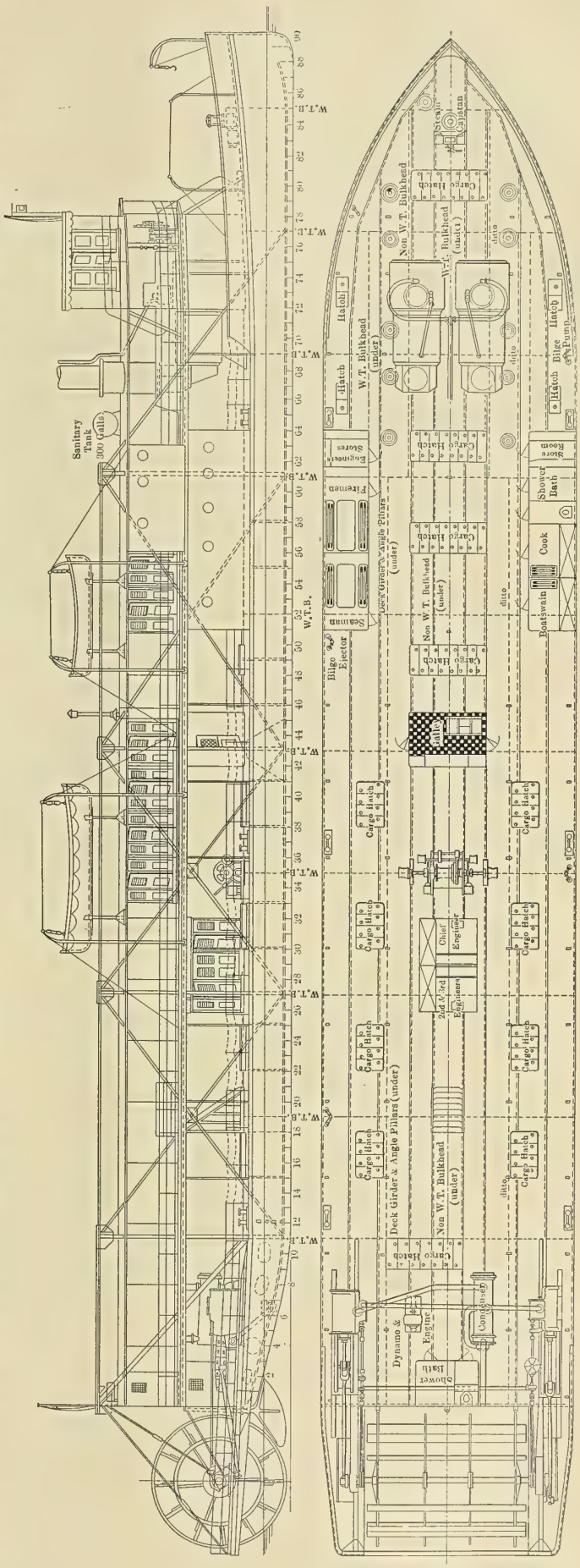

3" x 2½" x 5/16" Trussing Angles
Breadth of Shade Deck 30'
⅞" Teak T. & G. covered with Canvas
6" x 1⅛" Tie Plate
2" x 1½" x 3/16"
Beams 1¾" x 1¾" x 3/16" Spaced 24" apart
Pillars to Awning Deck, Spaced about 9'0" apart. See Deck Plans
2" Dia.
2" Dia.
Breadth of Promenade Deck 31'
2" x 1½" x 3/16"
5" x 1¼" Teak
Tie Plate 6" x 3/16"
Tie Plate 6" x 3/16"
Plate 7" x 3/16" 1¾" x 1¾" x 3/16"
Beams 2½" x 1¼" x 3/16" Spaced 24" apart
Camber of Promenade Deck 9" in full breadth
Plate 7" x 3/16" 1¾" x 1¾" x 3/16"
Pillars to Promenade Deck, Spaced about 9'0" apart. See Deck Plans
2½" Dia.
King Post 6" x 5" x 5/16" I bar
2½" Dia.
2½" Dia. Tube
8'
Deck Plating ⅜" Throughout
Cargo Hatch
Cargo Hatch
2" x 1½" x 3/16"
2" x 2" x 3/16"
15" x 15" x 3/16"
2½" x 1½" x 3/16" Angle Pillars in hold spaced three frames apart
Deep Brackets each side of King Posts
Frames 2½" x 1½" x 3/16" spaced 24" apart
Rev. " 1¾ x 1¾" x ¾" Across top of floors
To turn of Bilge butted alternately of Cr. Line
Floors 10" x 5/32"
Trans. Bulkhead 1/8" Stiffeners 1¾" x 1¾" x 3/16"
Stem 4" x ¾"
Rudder Stock 3¾" Dia. Plate 5/16"
3" x 2" x 3/16" 5 lbs. intcl.
Ceiling 1¼" P. Pine x 10" Wide
1¾" x 1¾" x 3/16"
1¾" x 1¾" x 3/16"
Non Wt. Bhd. in Holds ⅛"
3" x 2" x 3/16" 8" Plate Continuous

MIDSHIP SECTION.

smokebox and steam mountings, etc. The paddle-wheels are about 17 feet in diameter, fitted with twelve elm floats, which are capable of being reefed; the arms are securely bolted to cast steel centers, keyed to the paddle shaft. It was originally intended that the vessel should be erected, dismantled and packed for shipment, but unfortunately, owing to a strike of workmen, was delayed, with the result she was too late for the season on the route she was built for, and had to be placed on another of the railway company's numerous routes, thus necessitating the vessel being completed and tried under weigh in England.

On the official speed trial, which took place in the River Mersey, she developed a speed of nearly 12 knots, which was considered highly satisfactory by the owners' representatives.

After completion of trials the vessel was placed in dock and the paddle-wheels taken adrift, funnels removed and stowed, together with all movable gear, vessel ballasted and afterwards boarded up and otherwise prepared for the towage to Brazil, where the boarding was removed and the machinery, etc., fitted up ready for service.



OUTBOARD PROFILE AND DECK PLAN OF THE FRANCESCO SALLES, AN ENGLISH-BUILT VESSEL FOR BRAZILIAN RIVER SERVICE.

STERN-WHEEL MOTOR BOATS.*

BY LEWIS C. ALLEN.

Along the Ohio and Mississippi rivers alone there are thousands of stern-wheel boats—work boats used for herring fishing, clam shell gathering, towing and carrying passengers. These industrial boats are driven by internal combustion engines, and are much larger than pleasure boats. They are real competitors of the large steamboats in many instances.

About twenty years ago the single-cylinder horizontal stationary gasoline (petrol) engine was adapted to the propelling of shallow-water, stern-wheel boats, using two long drive belts, a countershaft, chain and sprockets. Countless

KEROSENE (PARAFFIN) ENGINED RIVER BOAT USED AS A FERRY.

attempts have been made to improve on this combination, but so far with small success in the large sizes.

At first sight this style of drive would appear to be about the most undesirable way of propelling a boat by an internal combustion engine, taking up, as it does, so great a portion of the available room on a boat, and making a load for a boat in itself by reason of its great weight; but in shallow draft boats all ordinary forms of propelling are disqualified because of lack of water under the boat to operate the blades in. This lack of water and space is still further augmented by the tendency that all boats have to sink at the stern, or draw down, as it is called, while running.

A great many attempts have been made to supplant the single-cylinder horizontal engine and its belt drive with a multi-cylinder engine and gears; but the single-cylinder horizontal engine, with all its drawbacks, has proved very efficient for this work. This is due in part to its slow speed and heavy fly-wheels. Then, too, you get a slight slippage of the belts on the pulleys under a sudden strain, and this is an advantage, although it would not seem so until you stop to think that the shock of reverse and starting must be absorbed somewhere.

An engine running at 200 revolutions per minute can be harnessed to a stern wheel running 35 to 50 revolutions per minute with less loss of power than a multi-cylinder engine of the same horsepower running at a speed of from 350 to 800 revolutions per minute, using the same method of speed reduction, and an investigation will show belt and chain transmission is more efficient than gear transmission. Then, too, the long shaft running fore and aft necessary with a gear transmission binds with the roll of the boat, and much care must be used in lining up the shaft, because of the necessity of great accuracy in meshing the gears.

The heavy fly-wheels of a horizontal engine balance the wheel, and are a decided advantage in a tight place, when the load is thrown on the engine suddenly, because the stored energy in the fly-wheels acts against the momentary overload. The acceleration or starting curve of a single-cylinder engine is sharper than that of a multi-cylinder. This enables this type of engine to gain its speed with greater dispatch in starting, and also helps it to resist the tendency to reduce speed when under an overload. In towing, the strong impulse of a single-cylinder engine at each explosion carries the boat along much better than a number of weaker impulses. The river men call this "grit," and they claim the single-cylinder engine has more towing "grit" than a multi-cylinder engine of the same horsepower.

The cost of repairs on a single-cylinder engine is low, because every part is large and strong, and the belts absorbing the sudden shocks, as they do, make the replacements on this form of transmission few and far between. Friction clutches are used on the larger sizes of single-cylinder engine equipments to accomplish the reverse, and the wooden friction blocks also help to absorb the sudden stresses and protect the engine. It is true that the multi-cylinder engine occupies less space and is lighter in weight, but the disadvantages are so many that the actual proportion is much in favor of the single-cylinder engine. Then, too, the single-cylinder engine is the simplest and least complicated engine of the two to operate, which is a factor on the rivers, where mechanics are few.

A common form of complaint against the single-cylinder engine—the vibration—can be overcome by the use of a throttling governor engine in harness with a staggered wheel. The throttling governor engine most commonly used is a combined fuel type of engine, and burns either kerosene

* From *The Gas Engine.*

(paraffin) or gasoline (petrol) or both, changing from one to the other without stopping the engine.

The most successful combination of belt and chain harness for horizontal, single-cylinder engines consists of a very wide-faced steel split driving pulley, fastened to the main shaft, which projects about half the distance through the pulley. A rubber disk is inserted so that it fits over the end of the main shaft; a second piece of shafting, long enough to reach an outboard bearing on the gunwale of the boat, is butted up against the rubber disk. This arrangement will not cause trouble when the boat rolls, as would a solid main shaft and outboard bearing; and it is not hard to keep the bearings in line. The cylinder end of the engine is placed toward the bow of the boat, and the the two drive belts (both on one side of the engine, as they are) enable the operator to get to all parts of the boat without going through the belts. The two belts can be carried close to the wall or bulkhead of the engine room, and the amount of space available on the boat for other purposes is greatly increased. The cross-belt is used for the "go-ahead" drive, because it has more grip on its pulleys as well as to eliminate the necessity of running the drive along the working side of the engine.

The stern bulkhead countershaft carrying two friction clutch pulleys should be at least 20 feet on centers from the engine shaft. The sprockets and chain, being located on the side of the boat opposite the belt drive, are almost an exact balance for the belts and pulleys, and by setting the engine a little off the center of the boat along the keel line a perfect balance can be obtained without using ballast. Pitmans can be used instead of a chain drive, but they are hard to keep in line and do not balance up as well. Being rigid on double centers they break much easier than a chain and give much more trouble when two pitmans are used. Rubber blocks and springs back of the boxes have been tried in an effort to eliminate this feature, but without the success anticipated. Several ratios of reduction are used. Generally the sprockets and chain do the major portion of the reducing, the proportions used being 4 to 1 in a great number of cases.

MOTOR PACKET BOAT USED ON AMERICAN RIVERS.

Loose pulleys, in combination with a tight one, are used in place of friction clutches in some cases, especially on the smaller sizes of boats. They have the advantage of being lighter and cost much less, but are not successful on wide belts, as the belts are too hard to shift. Reverse gears, such as are used in oil-field and marine work, have been tried, both on the main shaft and on the countershaft, also in connection with a large spur gear fastened to the bed of the engine; but, as a rule, they are not successful.

A large part of the trouble on a stern-wheel boat comes from the stern-wheel flanges cutting their keys and breaking their fastenings. This can only be remedied by substituting a hexagon shaft for a round shaft, as is done in steamboat practice. The strain on the wheel is further increased if the wheel is set too close to the stern bulkhead, as the water piles up on the wheel in making a quick reverse and adds greatly to the strain and also retards the speed of the boat in going ahead. The wheel should dip in the crest of the first wave back of the bulkhead. This wave is caused by the forward motion of the boat and consists of solid water coming

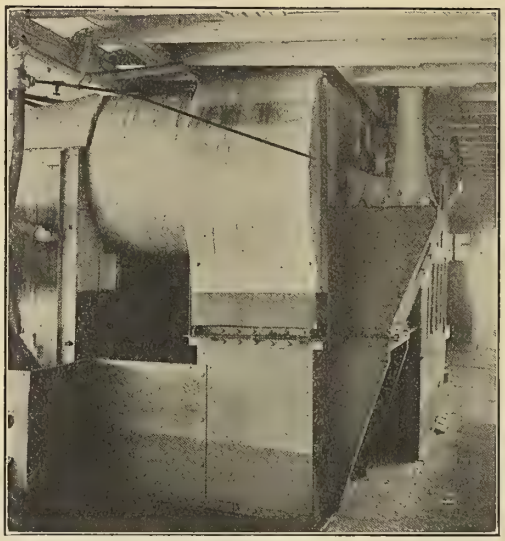
TYPICAL METHOD OF HANDLING FREIGHT BY A MOTOR PACKET BOAT.

from under the boat, and gives a much better purchase for the wheel than if it were set closer.

The advocates of a bevel gear driven wheel mention the split or double wheel with staggered paddles as an advantage; and anyone using it (and it can be used just as well with a chain drive) will find it reduces the vibration of the boat materially—and it is a wonder that more of the wheels are not built double.

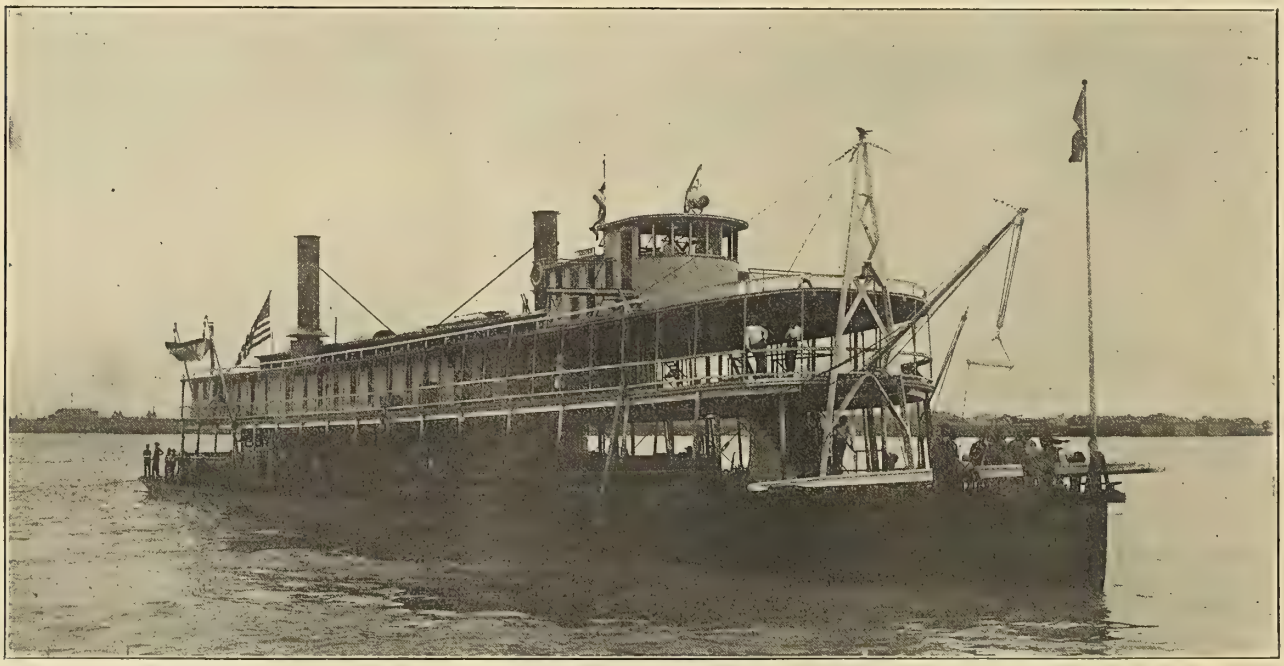
The amount of dip to give the paddles is a question that causes serious thought. One manufacturer shows in his catalogue an adjustable stern-wheel bearing that raises and lowers the wheel, and means for tightening the chain can be provided with this bearing. There is another way of regulating the dip that has lately come into use. Tanks or bulkheads are built in the bow of the boat, and a small centrifugal pump with a two-way connection enabling water to be pumped in or out is installed and can be driven by belt from the engine. Water as ballast can then be used to trim the boat. Experiments then will give the proper dip for greatest efficiency. Some use side tanks also, as a boat that is heeled over will not run as well as a boat in full trim.

One of the most common mistakes made by builders is to hog-chain the boat as they would a small steamboat. Just remember that the weight of machinery comes in a very different part of the boat in this case. Put your hog-chain braces in with some idea of taking care of the weight of the engine, and not with the idea of making the boat look like a steamboat. If you run timbers across the boat under the engine to form a saddle and swing this saddle on auxiliary braces running to the main chain braces it will strengthen the boat and eliminate some of the vibration.



SIROCCO FANS FOR FORCED DRAFT ON THE CHESTER.

boat, designed originally to use combination machinery, consisting of reciprocating and turbine engines, steam being supplied by watertube boilers using oil as fuel. This type of propulsion was expected to add much to the efficiency of this method of transportation. The boilers are fitted with a mechanical draft equipment, consisting of two full-housed, right-hand, top-vertical discharge, single-inlet Sirocco fans, with direct-connected 5-inch by 5-inch vertical inclosed self-oiling



LARGE RIVER STEAMER (CHESTER) REMODELED FROM A STERN-WHEELER TO A TRIPLE-SCREW TUNNEL BOAT.

RENEWAL OF NAVIGATION ON THE MISSOURI RIVER.

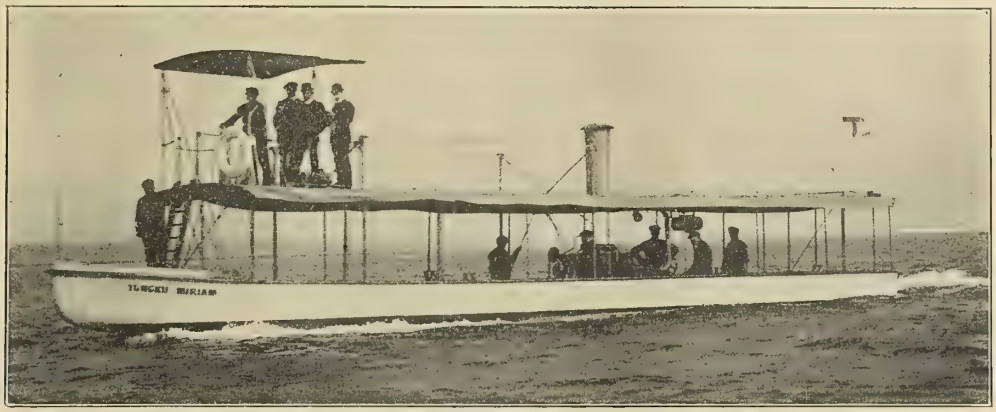
Attempts have been made during the last year to re-establish navigation of the Missouri River by the organization of the Kansas City Missouri River Navigation Company. This company has purchased two shallow-draft passenger and freight boats, both of which are of the tunnel type, arranged for screw propulsion. The first of these boats is the *Chester*, which has been remodeled from a stern-wheel boat to a tunnel steam engines, supplied by the American Blower Company, Detroit, Mich.

The other boat of this company's fleet is the *A. M. Scott*, which was illustrated and described in our November, 1910, issue. She is a light-draft steel towboat, 150 feet long, 26 feet beam, with a depth of 5 feet, equipped with triple-expansion condensing engines of 700 horsepower, driving twin screws, which give the boat a speed of 15 miles per hour. She was built by the Chas. Ward Engineering Works, Charleston, W. Va.

Tungku Miriam, a Shallow-Draft 63-foot Motor Vessel for the British Colonies.

BY J. RENDELL WILSON.

The *Tungku Miriam* is a shallow-draft vessel of an interesting type, recently designed, built and engined by Messrs. John I. Thornycroft & Company, Ltd., to the order of the Crown Agents of the Colonies, under the supervision of Messrs. Flannery, Baggallay & Johnson, who are the consulting engineers to the Crown Agents. She has not long since taken up her station on the Pahang and Perak Rivers in the Federated Malay States, where she is used for carrying officers and supplies. Her prototype, by the same builders, was the *Spider,* a rather smaller boat on the same lines, that has been running for about four years on the Cross River in Southern Nigeria, during which period she has successfully run in the neighborhood of 50,000 miles without a breakdown, in charge of two native engineers under the supervision of a white officer.



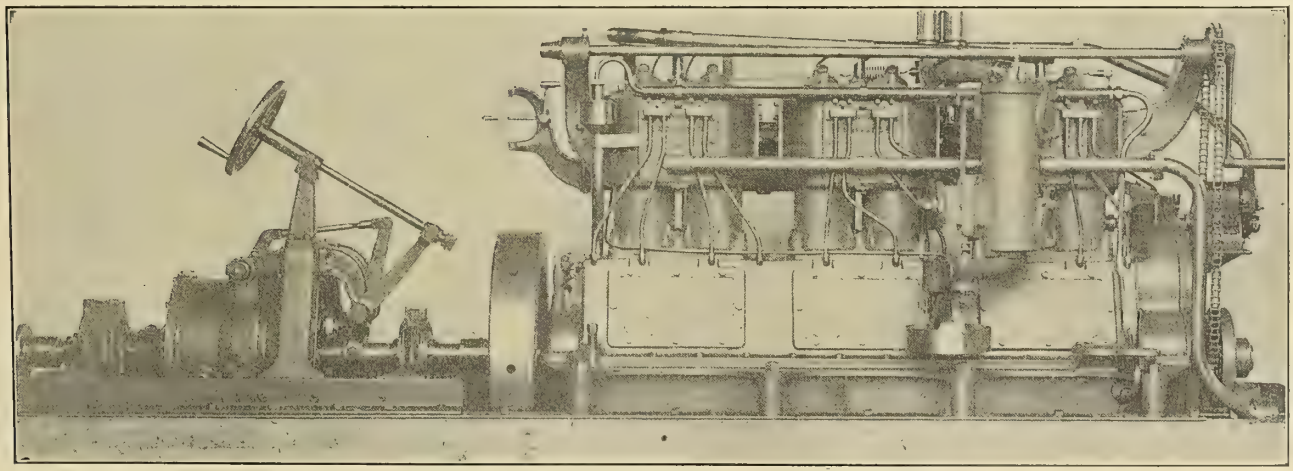
TUNGKU MIRIAM, A POWER CANOE FITTED WITH A 90-HORSEPOWER THORNYCROFT MOTOR.

Tungku Miriam is built of steel and the hull is entirely open, with the exception of a short flush-deck forward. She is 63 feet 2 inches long over all, with a molded breadth of 9 feet and a depth of 2 feet 10 inches. Her draft with a load of 4 tons is but 14 inches, the hull being quite flat-bottomed excepting right forward. The hull is divided by six watertight bulkheads, and the boat will float with any two compartments flooded.

It is interesting to note that three semi-balanced rudders have been fitted, which give her excellent maneuvering qualities, rendered necessary by the winding nature of the rivers on which she is working. The steering control is carried to the roof of the permanent asbestos-covered wooden awning right forward, which is mounted on steel tubing, and in its turn sheltered from the sun's rays by a smaller awning. This arrangement gives the helmsman an excellent outlook over distant low-lying banks. The main awning is also used as a promenade deck, wire guards being fitted.

Her machinery, which is arranged just abaft of amidship, consists of a six-cylinder Thornycroft gasoline-kerosene (petrol-paraffin) engine of the four-cycle type, driving two propellers on one shaft in a tunnel, through a clutch and reverse gear. The cylinders are each 6-inch bore by 8-inch stroke, and 70 horsepower is developed at 560 revolutions per minute on kerosene (paraffin) fuel, gasoline (petrol) being only used for starting if required. Under normal conditions the engine is run at 450 revolutions per minute.

The engine follows the latest Thornycroft marine practice, with the exhaust and inlet valves arranged on the port side. The reverse gear is controlled by a wheel, a couple of turns being sufficient to send the vessel from full speed ahead to direct astern. On the port side, between the reverse gear and the engine, the control levers are arranged on a perpendicular cast iron standard, directly overhead of which is a speaking tube carried from the steering wheel. On either side of the machinery is a large oval-shaped brass fuel tank, with gages and safety devices, yet leaving ample room for the engineers to work. The exhaust gases are carried to a water-cooled silencer on the awning, just abaft amidship.



STARBOARD SIDE OF THE TUNGKU MIRIAM'S THORNYCROFT MOTOR, SHOWING REVERSE GEAR.

On her trials *Tungku Miriam* attained a speed of very nearly 12 knots over the measured mile, and when towing a 25-ton barge she made 6.35 miles an hour.

LIGHT DRAFT TUG MARIA HENDRIKA III.

BY D. KOOIJMAN.

Steam tugs designed for light draft river work and harbor construction, with, at the same time, sufficient sea-going qualities to enable them to do some towing at sea, have been constructed by J. Constant, Kievits & Co., Ltd., Dordrecht, Holland. One of these tugs is shown in Fig. 1. The vessel has been built in excess of Lloyd's rules and has been classed 100 A 1 for towing purposes. Her principal dimensions are:

Length, over all	100 feet
Length, between perpendiculars	91 feet 10 inches
Depth, molded	18 feet 8 inches
Breadth, molded	18 feet 8 inches

The draft is 7 feet aft, and on a mean draft of 5 feet 10 inches she carries 10 tons of coal. The total bunker capacity is 50 tons. In fore-and-aft peak tanks 15 tons of fresh water can be carried for boiler-feeding purposes; these tanks are connected with the donkey pump, and the feed pump can take the fresh water from the after peak tank. At the sides of the boiler side bunkers are situated, having large square hatches on deck, and these side bunkers are connected together by a cross bunker, which has a tunnel for communication between the engine room and stokehold. On the top of the cross bunker, the towing post and steam winch for hawsers are placed; the post is equipped with three double spring loaded tow hooks, and the winch is so arranged that the steel wire ropes can be lodged on the long barrels when the ropes are taken in, and has also two cast iron drums to maneuver the manila hawsers.

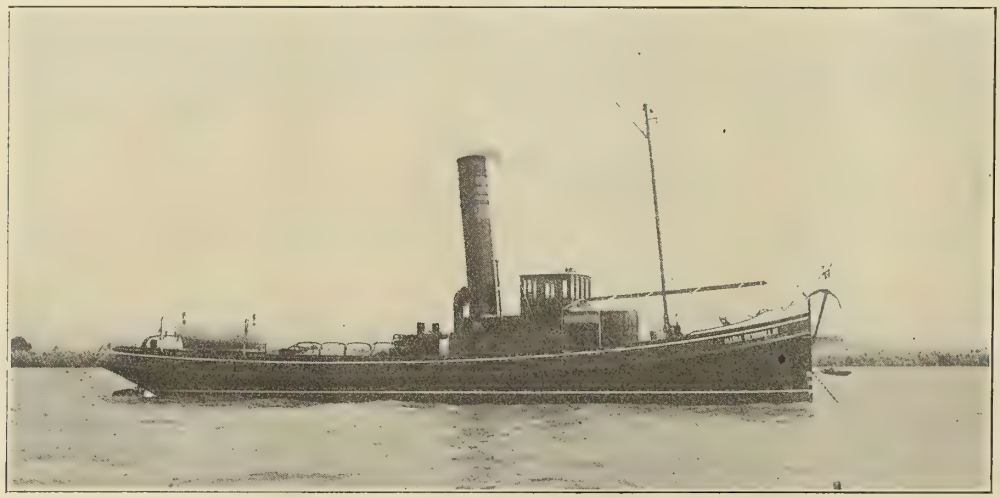


FIG. 1.—RIVER TUG MARIA HENDRIKA III.

The arrangement necessary to lodge a crew of ten has been a point of special consideration. The officers are berthed forward of the boiler space under the deck, a wide staircase leading from the steel deckhouse forward of the boiler casing. The saloon is fitted in mahogany, with seats at the sides and two small cupboards, and a teak skylight over the saloon. There are separate cabins for the master and engineer, and a double-berthed cabin for the mate and second engineer. On the port side in the steel deckhouse is the galley. The crew is berthed aft in one compartment.

HULL CONSTRUCTION.

The bar keel is 5 inches by 1¼ inches, the stem of hammered steel 3½ inches by 2 inches. The stern frame is in one piece of hammered steel, 5¼ inches by 2¼ inches, the frames are 2½ inches by 2 inches by 5/16 inch, and are double in the engine and boiler space. They extend in one piece from the keel to the deck stringer plate. The reverse frames are 2 inches by 2 inches by 5/20 inch across the top of floors only. Floor plates 10 inches by 5/20 inch are fitted to every frame. The boiler and engine bearers are 5/16 inch, the latter in one plate. The watertight bulkheads are 5/20 inch, their stiffeners are 2 inches by 2 inches by 5/20 inch. There is a keelson 5/20 inch, made intercostal with two angles 2½ inches by 2½ inches by 5/20 inch on the topside. Under the boilers there are on each side 12 inches intercostal plates, thickness 5/20 inch, secured with two angles, 2½ inches by 2½ inches by 5/20 inch, to the hull plating, and with two such angles riveted to the top. Under the engine the floor plates extend to the underside of the engine seat. These floor plates are riveted to the top plate, which is ½ inch, with two angles, 3 inches by 3 inches by ⅜ inch.

The engine is bolted to the top plates by 25 bolts ¾ inch diameter, and of which twenty pass through the angles. Intercostals of ⅜ inch steel plates are worked under the engines in way of the holding down bolts, secured to the shell and top plate by double angles 3 inches by 3 inches by ⅜ inch. There is one side stringer, extending all fore and aft of double 2½ inches by 2½ inches by 5/20 inch angles, riveted back to back and to the double lugs; they are bracketed to the bulkheads and are connected at the ends of the vessel with 5/20 inch plates forming breast hooks.

The main deck beams are 3 inches by 2 inches by 6/20 inch. In the engine and boiler rooms they are 3½ inches by 2 inches by 6/20 inch fitted on every frame and connected to the frames by steel bracket plates 12 inches by 12 inches by 5/20 inch. The shell plating on the sides and bilges is of 5/20-inch plate, the sheerstrake 3/20-inch. The bulkhead strake is 5/20 inch. The deck forward of the boiler room is of pitch pine 3 inches by 4 inches, after the boiler bulkhead it is of steel check plating 5/20 inch. The side plates of the boiler casing are 3/16 inch, with stiffeners 2½ inches by 2 inches by 5/20 inch, the top plate 3/16 inch check plate.

PROPELLING MACHINERY.

The main engine and boiler have been built by Maschinefabriek "Bolnes," v/h. J. H. van Cappellen in Bolnes, near Rotterdam. The main engine shown in Fig. 4 is of the direct-acting, inverted cylinder, triple-expansion type, having cylinders 12 inches, 17¼ inches and 29 inches in diameter, with a common stroke of 15 inches. All valves are worked by the Stephenson's overhung link gear, the reversing of the engine being operated by a handwheel. The engine cylinders

are cast separately. The high and intermediate-pressure cylinders are fitted with a piston valve, provided with solid cast iron packing rings. The upper ends of the piston valves are ⅛ inch larger in diameter than the lower part, so as to take out the valves easily from the topside. Liners of hard, close-grained cast iron are fitted in the intermediate-pressure and high-pressure steam chests, held down by the covers on the top and bottom side. The low-pressure cylinder is fitted

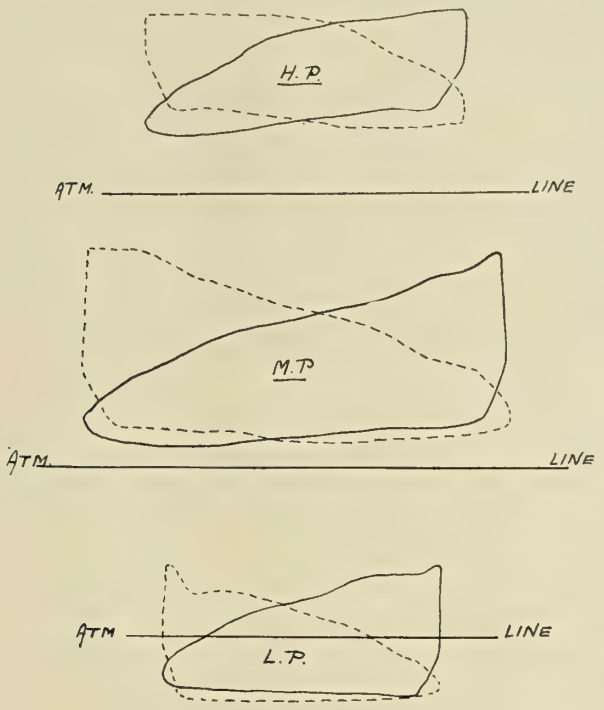


FIG. 2.—INDICATOR DIAGRAMS.

with a double-ported slide valve. The steam passages and pipes are designed for moderate steam velocities, when the engine is turning at about 200 revolutions. The minimum thickness of the cylinder walls of all cylinders is 1⅛ inches. The cylinders are fitted together, and to their supports, by ¾-inch bolts, driven into reamed holes. The clearances at

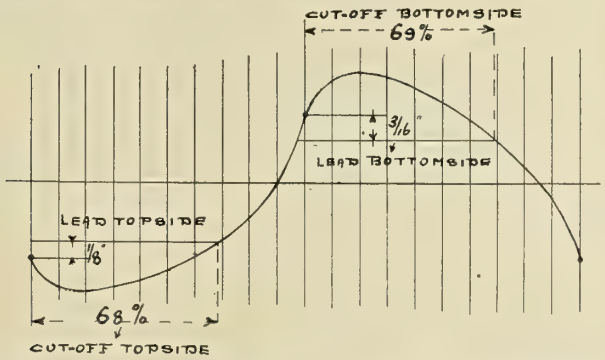


FIG. 3.—DIAGRAM SHOWING STEAM DISTRIBUTION IN HIGH-PRESSURE CYLINDER.

top and bottom are, in the high-pressure cylinder, 3/16 inch and ¼ inch; in the medium-pressure cylinder ¼ inch and 5/16 inch, in the low-pressure cylinder ⅜ inch and ½ inch. Relief valves, with a minimum diameter of 2 inches, with brass valves and seats and adjustable protected steel springs, are fitted to each end of each cylinder; ½ inch-drain cocks are fitted to the cylinders and receivers, thus from the high-pressure receiver a pipe leads to the casting on the ship's side for the circulation suction valve, to serve for heating the circulation water in freezing weather; the other pipes are led to the condenser. A two-way cock, 1 inch bore, may pass steam to the intermediate-pressure and low-pressure receivers for starting purposes. The steam for this cock is taken from the main steam pipe after the engine stop valve.

The engine framing consists of three front columns of forged steel 3 inches in diameter; the back columns are cast on the condenser and fitted with close-grained cast iron guide plates securely bolted on. Between the guide plates and the condenser columns water may circulate for cooling purposes. The pistons are of sound cast iron, 4 inches deep, fitted with Ramsbottom cast iron springs. The junkrings, very stiff, are held down with ¾-inch steel bolts. The piston rods are of Siemens-Martin steel, 2¾ inches in diameter; the crossheads are of forged steel, with pins 3¼ inches diameter by 3¼ inches long, forged solid with the crossheads. The piston rod is fitted to the crosshead with a taper of 1 in 4, with a shoulder of 1/16 inch, being the same at the attachment to the piston. The piston rod screws are 2 inches. To the

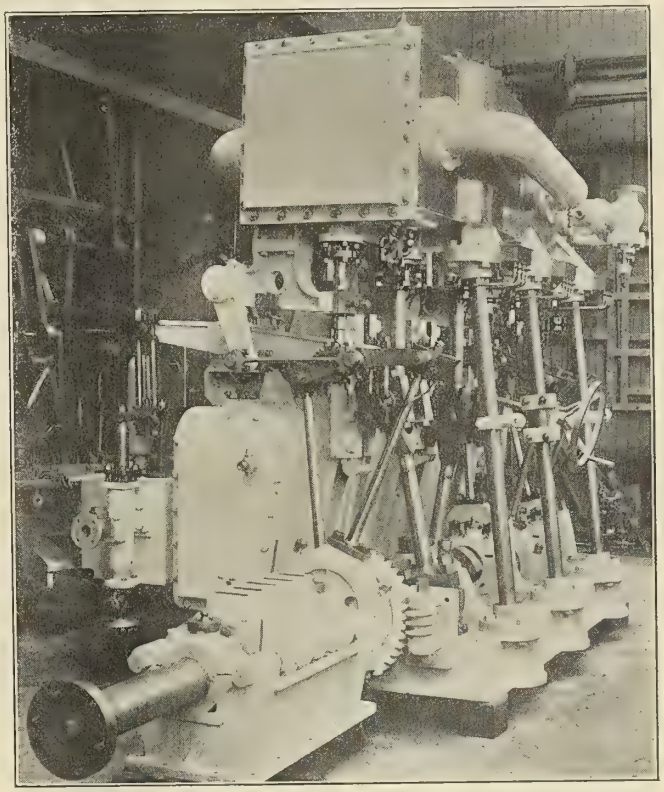


FIG. 4.—MAIN ENGINE.

crossheads are secured cast steel slippers, the slippers directly running on the cast iron slides. The crosshead pins are all hardened and truly ground. The connecting rods are of mild steel, forged from a solid bloom without welds. The top end is forked to take the crosshead brasses. The length from the center of crank pin brasses to center of crosshead brasses is 2 feet 11 inches; the diameter at the crank end is 3 inches, tapering to 2¾ inches at the crosshead end. The crank pin brasses are of brass lined with white metal. The brasses were carefully tinned before the white metal was poured in. The crosshead brasses are of gun metal, not lined. The diameter of the crank pin is 5½ inches, the length of same 6 inches.

The crankshaft is 5½ inches in diameter, of forged steel, in one piece. The cranks are set at 120 degrees, with the high-pressure crank leading. The breadth of the arms is 6¼ inches, the thickness 3½ inches, the flanges of the shaft are 10½ inches by 1½ inches thick. The thrust shaft is 5½

inches in diameter under the collars, at the ends the shaft is 5¼ diameter. The thrust bearing is of the horseshoe type. There are five cast iron shoes, lined on both sides with white metal ⅜ inch thick. On the shaft are six collars, diameter 10¼ inches. The bearing surface is 220 square inches, giving at 10 knots from the mean normal thrust a pressure per square inch of 45 pounds. The bottom of the block forms an oil bath; this oil is cooled by water from the circulating pump. The bearing surfaces are all well grooved for lubrication. On each side of the thrust block is a bearing lined with white metal to support the weight of the shaft. The intermediate shaft is of the same quality as the crankshaft; the diameter is 5¼ inches. There is one intermediate shaft bearing, 8 inches long, of cast iron, lined with white metal in the lower half. The tail shaft is also of steel, 6 inches smallest diameter. The stern tube is made of cast iron, with a flange at inner end, by which it is attached to the bulkhead. The cast iron bush at the outer end is lined with white metal, and the cast iron packing gland is also lined with white metal.

The engine bed plate is of the box style of cast iron, bolted to the engine seat. The flat-bottomed bearings are of cast iron lined with white metal; the bolt holes are bored half in the brasses and half in the bed plate, so as to prevent the brasses from shifting. At the after end of the engine a turning gear is placed; a worm wheel is keyed on the flanges of the crankshaft and thrust shaft, the cast iron worm is keyed to a steel pin which may be turned by a wrought iron ratchet. The worm is arranged to be put in and out of working position easily. The high-pressure and intermediate-pressure steam valves have solid rings, which are arranged to have a little play on the valves; the valve spindles are 1⅛ inches in the valve and 2 inches in the stuffing-boxes. The spindles are screwed with checknuts into the part sliding in the guide. The guide has phosphor bronze adjustable bearings. The low-pressure valve is double ported, and has a web at the back to keep the valve up to face.

The valve gear is of the Stephenson overhung type; this type was chosen because the steam distribution is in this case better than when the center of the valve spindle coincides with the center of the eccentric rod. In the latter case the steam admission on the top side of the piston is always later than on the bottom side. When the links are overhung the cut-off at top side and bottom side are very nearly equal, or at bottom side a little later, which arrangement is better. In Fig. 3 a diagram is shown, from which may be seen that the steam admission on both sides of the pistons are nearly equal.

The engine is reversed by means of a hand-wheel which turns a threaded rod. By five turns of the hand-wheel the levers are changed from full ahead to full astern. Due to the balanced high-pressure and intermediate-pressure steam valves the engine is very easily reversed. All bearings of the valve gear are adjustable, the high-pressure drag rod lever is provided with means for easily altering the steam admission in the high-pressure cylinder without stopping the engine and without altering the cut-off in the intermediate-pressure and low-pressure cylinders.

The condenser is of cast iron, and is connected to the bedplate with a horizontal joint. The back columns are cast on the condenser. The tubes, of solid drawn brass, are ¾ inch in diameter by No. 18 W. G.; they are packed in the tube plates by cotton packing and screwed glands. The tube plates are of rolled brass and ⅞ inch thick, the center plate is ½ inch thick. There are 336 tubes, which are 7 feet 9½ inches long between tube plates, giving a cooling surface of 515 square feet. A feed heater is bolted to the top of the condenser, the feed-water is therein heated by the exhaust steam; it is further heated in a second feed heater by steam from the intermediate-pressure receiver, which is led into a coil. A baffle plate is fitted opposite the exhaust steam inlet, a distribution plate is fitted between the two tube nests over three-fourths of the length of the condenser, so that the exhaust steam must flow from the aft end to the fore end of the condenser and then to the air pump inlet. The cooling water circulates two times through the condenser. The suction and delivery pipes for the cooling water are 3 inches in diameter. There are two small doors 5 inches diameter in the condenser to sight the tubes.

The single-acting air pump is of the Edward type, 10 inches in diameter, the stroke being 7½ inches; the pump chamber, the piston, the gland, neck bush, head valve seats and guards are of bronze, the rod of gunmetal. There is a weir to keep 2 inches of water over the head valves. The bottom of the pump is 6 inches below the bottom of the condenser. The waste pipe is 3½ inches in diameter; to the bottom of the hot well a 1¾-inch pipe with valve is fitted. The circulating pump is double-acting, 6½ inches in diameter by 7½ inches stroke, with bronze chamber, piston, gland, neck bush, suction and delivery valve seats and guards. The rod of gunmetal, the valves of rubber. The feed pump is single-acting, 2¼ inches diameter by 7½ inches stroke; the ram, of bronze, is rounded at the bottom; the air vessel has a capacity of four times the capacity of the pump. The bilge pump is of the same size as the feed pump, but is not provided with an air vessel nor with a relief valve. The pumps are driven from the low-pressure crosshead by cast steel levers of the T form.

The right-handed propeller is of cast iron in one piece. The diameter is 5 feet 11 inches, the pitch 5 feet 4 inches, and the projected area 14 square feet.

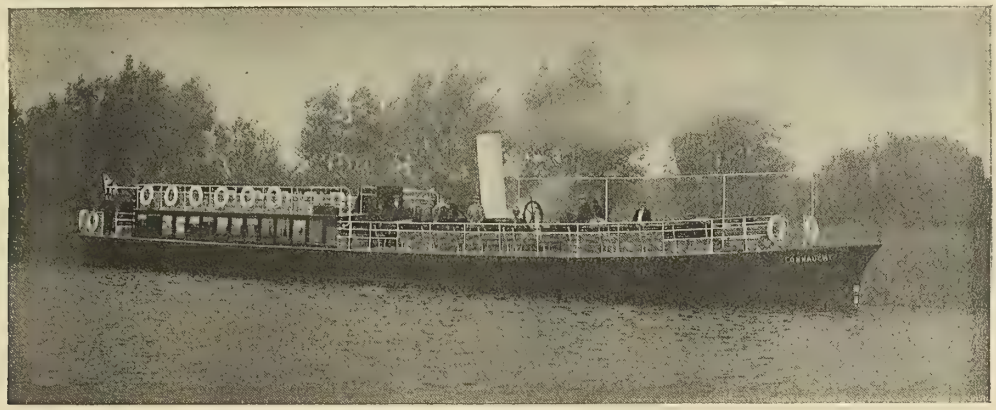
The boiler is fitted in the ship 2 inches to the starboard side, to balance the condenser, pumps and feed tank. It is of the two-furnace single-end Scotch type, 10 feet 8 inches diameter and 9 feet 9¼ inches long. The furnaces are of the Morison type and withdrawable. The combustion chambers are separated. The tubes are lap-welded, of iron 3¼ inches external diameter by 6 feet 9 inches long between the tube plates; the plain tubes are No. 10 W. G. thick, the stay tubes ¼ inch. The plain tubes are swelled 1/16 inch at one end, the stay tubes also at one end and threaded with ten threads per inch at both ends. The stays in the steam space have the nuts and washers in one piece, riveted to the front ends. The shell is in one plate, the longitudinal seams are double-butt straps, and treble riveted, the seam lying in the steam space; the circular seams at the ends are double riveted. The front and back end plates are in one piece. The diameter of the funnel is 3 feet 7 inches, and it is made to be lowered. The heating surface of the boiler is 1,162.5 square feet, the grate surface 350 square feet. The boiler was tested to 290 pounds per square inch water pressure.

The trial trip took place on the River Maas, between Rotterdam and Hoek van Holland. The indicator diagrams, taken on the full-power trip, are shown in Fig. 2, the boiler pressure being 195 pounds, the engine turning with 226 revolutions and indicated 412 horsepower (129 in the high-pressure, 160 in the intermediate-pressure and 123 in the low-pressure cylinders). The steam pressure in the intermediate-pressure receiver was 65 pounds per square inch, in the low-pressure receiver 9 pounds per square inch, the vacuum was 25 inches. The draft of the boat was 4 feet 11 inches forward and 6 feet 8 inches aft. The temperature of the sea was 40 degrees, of the engine room 74 degrees, of the stokehold 76 degrees, on deck 42 degrees and of the circulation discharge 125 degrees. The boat attained a mean speed of 10.3 knots.

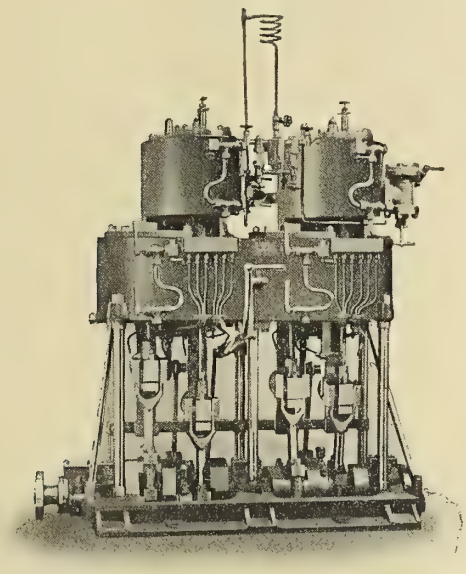
All records for unloading iron ore in a day of twenty-four hours on any Lake dock were broken recently at the docks of the Pittsburg & Conneaut Dock Company, when 61,661 tons of ore was unloaded from eight ships at the rate of 2,569 tons per hour.

SINGLE-SCREW TUNNEL LAUNCH CONNAUGHT.

The light draft single-screw tunnel launch *Connaught*, specially designed for passenger service on the River Thames, is of the following dimensions: Length over all, 110 feet; between perpendiculars, 108 feet; beam, molded, 16 feet 6 inches; depth, molded, 5 feet; draft, 2 feet 3 inches; tunnel, 1 foot 9 inches high. The launch was built by Messrs. Salter Bros., but the lines were worked out by the builders of the machinery, W. Sisson & Company, Ltd., engineers and naval architects, Gloucester. The hull is constructed throughout of mild steel, the deck and cabins being of teak, and the vessel throughout extremely well fitted and arranged for carrying a large number of passengers with comfort.



SINGLE-SCREW TUNNEL LAUNCH CONNAUGHT.



SISSON COMPOUND ENGINE FOR TUNNEL LAUNCH.

The machinery is of the compound surface-condensing type, but not of the ordinary design, the engines being of four-crank type with partially superposed high-pressure cylinders, as in the case of the Sisson patent vertical high-speed, double-acting enclosed self-lubricating engine, but otherwise similar to their standard light framed marine engines. These engines have two high-pressure cylinders, each 6 inches diameter, and two low-pressure, each 12 inches diameter, the stroke of all four being 6 inches. The valve and reversing gear is of a type similar to that used in the above-mentioned engine, but, of course, adapted to this particular type of engine. The surface condenser is independent, and formed of a mild steel shell, galvanized after completion, and fitted with rolled yellow metal tube plates and seamless brass tubes secured by screwed glands and cotton packing. The air, circulating, feed and bilge pumps are also independent and worked by a single steam cylinder, which exhausts into the intermediate receiver of the main engines. The boiler is of the makers' special design of watertube boiler, the working pressure being 165 pounds per square inch. The vessel itself and the whole of the machinery were constructed throughout in accordance with the Board of Trade requirements so as to obtain the necessary certificate for passenger service.

Tow Boats for Florida Rivers.

The tug *Vixen*, owned by M. C. Hutto, Jacksonville, Fla., is a gasoline (petrol) boat 50 feet long over all, 11 feet beam, with a draft of 4 feet 6 inches. The engine is a 50-horsepower Buffalo heavy-duty engine, manufactured by the Buffalo Gasoline Motor Company, Buffalo, N. Y. This motor gives the boat a speed of 12 miles an hour. The illustration shows the boat at her daily work towing three lighters, 80 feet by 28 feet, loaded with 10,000 railroad ties and drawing from 5 to 6 feet of water.

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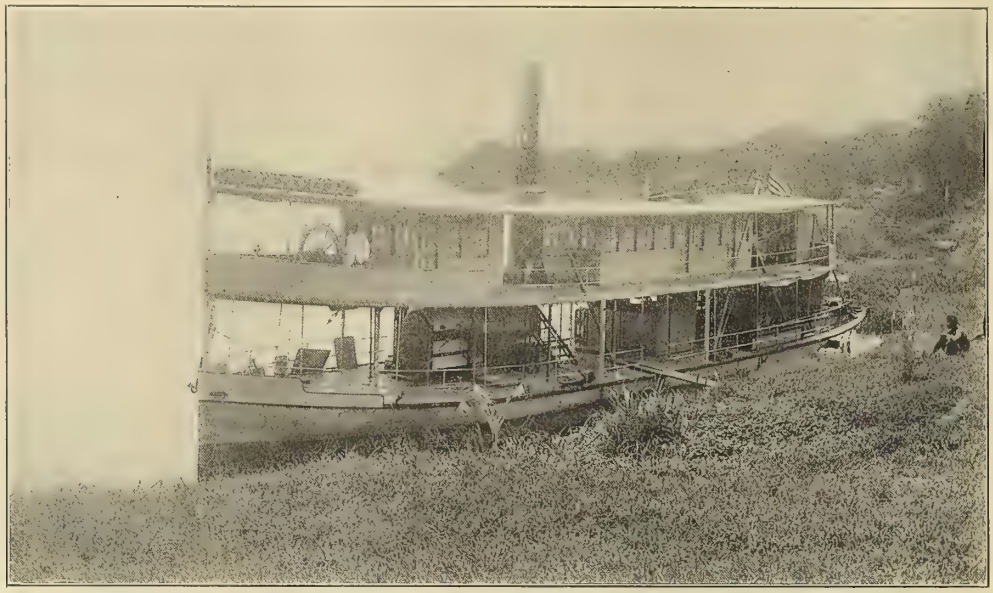
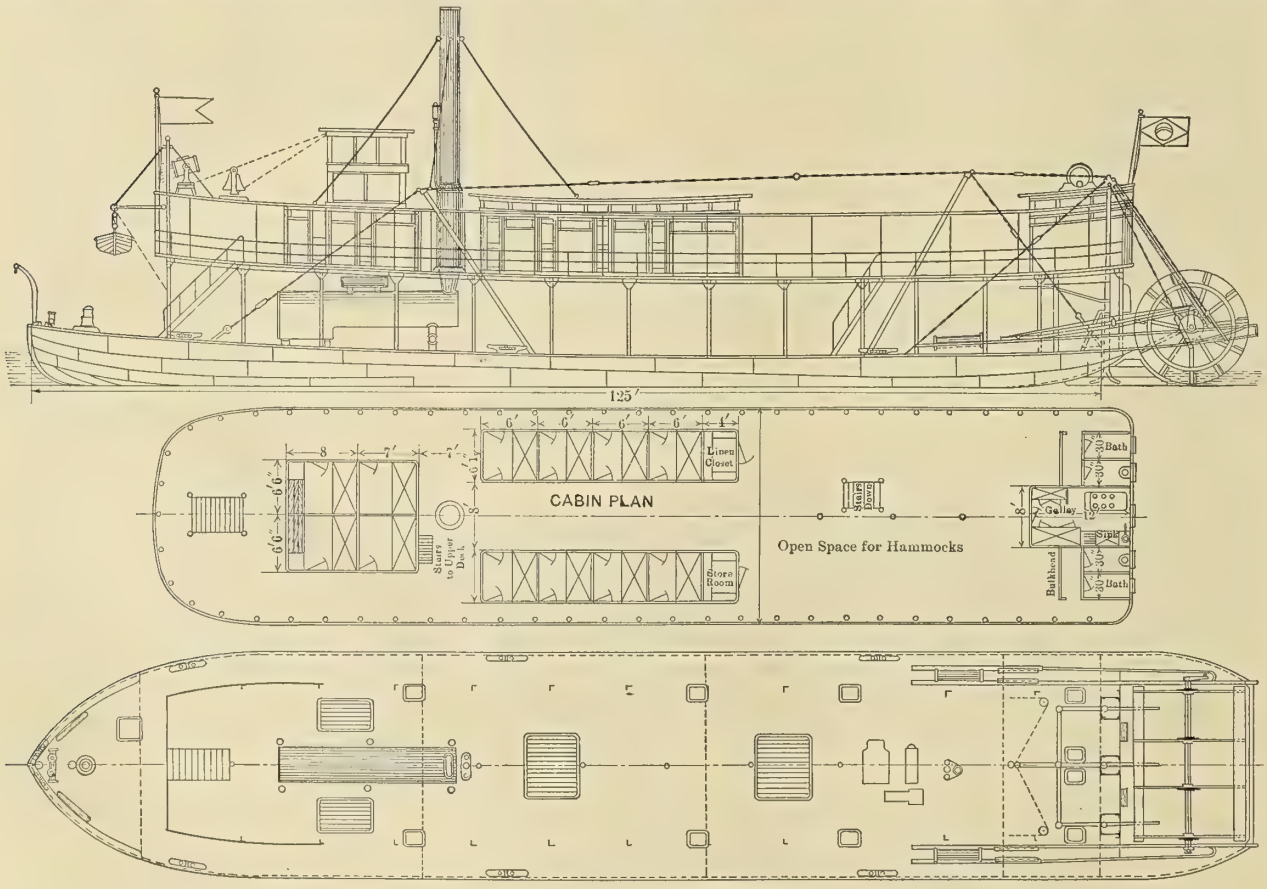
AMERICAN STERN-WHEEL RIVER BOATS.

There is probably no place in the world where steam navigation on shallow rivers has reached such a magnitude as was the case about fifty years ago on the Western rivers of the United States. The great demand and necessity for successful steamboats for this service resulted in the development of a type of steamboat which may be called purely American. By this we refer to the stern-wheel river steamer which has been used for freight, packet and passenger boats, and also for towing purposes where immense cargoes are carried in a single tow.

Although river transportation on Western rivers in the United States has now been overwhelmed in most cases by railway competition, nevertheless the type of river steamboat developed in early days and steadily improved has been kept in constant use, and is now being supplied to navigable rivers in foreign countries. During the last year, James Rees & Sons Company, Pittsburg, Pa., built a boat for this type for the Missionary Society of Oregon for the African Mission of that



AMERICAN-BUILT STERN WHEELER IN THE CONGO MISSION SERVICE.



MAIN DECK PLAN

DESIGN OF NEW AMERICAN BOATS FOR NAVIGATING THE UPPER REACHES OF THE AMAZON.

Church, having their headquarters at Bolenge Station, Congo Belge, W. C., Africa. This boat is 75 feet long on the deck, 18 feet beam and 4 feet depth of hold. She is equipped with engines 8 inches in diameter, 27 inches stroke, supplied with steam by a locomotive type of boiler designed to burn wood. Her speed is ten miles per hour. The general arrangement of the boat is shown in the illustration.

Another stern-wheel freight and passenger steamboat was built during the year by the same firm for the Magdalena River in the Republic of Colombia, South America. This boat, named the *F. Perez Rosa,* is 170 feet long, 38 feet beam, 4½ feet depth of hold. She is equipped with high-pressure engines with poppet valves with adjustable cut-off. The cylinders are 15 inches diameter by 6 feet stroke. Steam is supplied by three tubular boilers of the Western river type, 14 feet long, 48 inches diameter.

LARGE ENGLISH-BUILT RIVER STEAMER FOR THE AMAZON.

Another contract for fourteen stern-wheel river boats for the port of Para, Brazil, to ply on the Amazon River and the several tributaries, has also been received by this concern. These boats are designed especially to reach the upper head waters of the river beyond the points which are commonly called the navigable parts of the river. The boats are designed to carry about 40 tons on a draft from 24 to 26 inches, having a speed of ten miles per hour in dead water. The length on the deck to the main transom is 125 feet, the beam 26 feet, the depth of hold 3 feet 6 inches, the sheer 3 feet. The hull and cabin framework are of steel, the hull having three longitudinal bulkheads and three transverse bulkheads, making in all seventeen watertight compartments. The cabins are on the upper deck, as shown in the drawing. The machinery for these boats consists of engines 9 inches diameter, 48 inches stroke, supplied with steam from locomotive boilers having 800 square feet of heating surface. The boats are to be lighted by electricity.

It is interesting to note that these boats, when completed, will be run by skilled American steamboat men; that is, the captain, pilot and engineer will be taken from different Western rivers in America.

A Stern-wheel Missionary Boat.

The stern-wheel steamer *Bamania St. Joseph,* built by Wilton's Engineering & Slipway Company, Rotterdam, for the Belgian Missioners in the Congo, has a length of 56 feet, a beam of 16 feet 5 inches, a depth of 3 feet 5⅜ inches, and a draft of 2 feet 5½ inches. The engine is of the twin-cylinder non-condensing type, with discharge in the funnel. The cylinders are 12 inches diameter and 29½ inches stroke. The designed horsepower was 75, with 40 revolutions per minute, giving the ship a speed of 8 knots. The boiler is of the multi-tubular marine type, with 340 square feet heating surface and 105 pounds working pressure. It is 6 inches diameter, with a length of 9 feet 6 inches and a special grate arrangement for burning wood. The paddle-wheel is 10 feet 4 inches outside diameter, has nine radial blades 8 feet 3 inches wide.

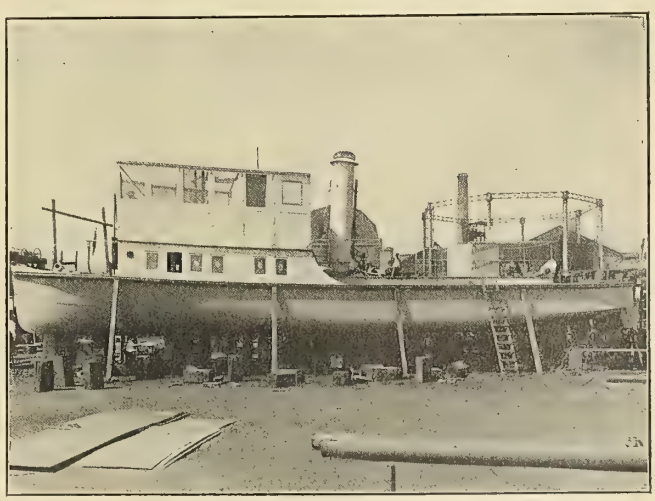
Single-Screw Amazon River Steamer.

The single-screw river steamer *Excellencia,* 145 feet by 30 feet by 8 feet 6 inches, has been built by the Smith's Dock Company, Ltd., Middlesbrough, for service on the Amazon River. This boat is propelled by a triple-expansion engine, with cylinders 12¼, 20 and 34 inches diameter and 22 inches stroke, driving a single screw. Steam is supplied by a single boiler at 180 pounds working pressure. The designed speed is 11 miles per hour when the boat is loaded.

The hull is built with three decks, the main deck being steel sheathed with teak, the promenade deck of teak, and the awning deck of teak covered with canvas. A teak deck-house is built on the promenade deck, containing passenger staterooms. The dining saloon is located aft on the same deck. Electric lights are installed throughout the boat, and fans are supplied in the deck-houses. The auxiliaries include an ice-making plant located on the main deck aft, a steam-steering gear, a steam windlass and two steam winches.

Tunnel Steamer for the Amazon.

Every year more rivers are being opened up in distant parts of the world, which necessitates the design and construction of



TWIN-SCREW TUNNEL BOAT BEFORE SHIPMENT.

shallow-draft steamers to suit the special local conditions. The latest shallow-draft steamers constructed at the yard of Messrs. G. Rennie & Company are for the exploration of some of the higher reaches of the Amazon River. The primary conditions which these vessels had to fulfill were as follows: Length not to exceed 58 feet 6 inches, breadth 10 feet 6 inches, draft 2 feet 3 inches loaded. The owners were anxious to obtain the accommodation usually found on steamers of 70 to 80 feet, and great care had to be taken to utilize every available bit of space in the boat.

Regarding the general arrangement of these steamers, the upper deck is arranged to be entirely mosquito proof, with copper gauze portable panels on a wood frame. The forward part is arranged for slinging six hammocks for the officers. There is a bath and toilet arranged on this deck. Below the deck there is a small saloon with seats and table, a pantry, the captain's cabin, refrigerating room and toilet. The vessel is lighted throughout with electric light, and the refrigerating plant is also driven by electricity. Aft of the engine room are two small houses, one for a galley and one for a shower bath. The whole of the woodwork is carried out in three-ply "Venesta" wood on account of its lightness and strength.

The machinery consists of compound surface-condensing engines of 140 indicated horsepower, driving twin screws in tunnels at 500 revolutions per minute. The boiler is of the watertube type for burning wood fuel or coal. A fan is driven off each engine to assist draft.

On trial, with all weights on board, the speed of the vessel was 11.25 knots, the guaranteed speed being 10 knots. The draft forward was 1 foot 6 inches and aft 1 foot 10 inches.

GAS ENGINES: THEIR DESIGN AND APPLICATION.

BY E. N. PERCY.

(*Continued from page* 418.)

Referring back to Table 3 (page 352), the compression in the most modern gasolene (petrol) practice will be noted. The various compressions in practical use to-day run about as follows:

GASOLENE (PETROL) AND DISTILLATE CARBURETOR TYPE.

Conservative, heavy-built, slow-speed stationary or marine type developing power on ⅛ to 1/10 of a gallon per horsepower per hour, 65 to 70 pounds.

High-speed motor boat and pleasure boat engines, 80 to 90 pounds.

Small gasolene (petrol) engines of all kinds, 100 pounds and up.

Alcohol and kerosene (paraffin) engines, 110 to 120 pounds.

GAS ENGINES.

Rich gases, 110 to 130 pounds; weak gases or producer gas, 150 pounds and up.

Pre-ignition is largely dependent upon the size of the cylinder and the shape of the combustion chamber, as well as on the compression. For instance, with gasolene (petrol), which is more apt to pre-ignite than any other fuel in common use, a very small engine will run as high as 200 pounds compression and engines are actually manufactured in two and four-horsepower sizes, giving no trouble and never pre-igniting, whereas a 14-inch gasolene (petrol) engine cylinder will frequently pre-ignite if not carefully cooled at 90 pounds.

For economy it is essential that the combustion chamber or compression space be as nearly globular as possible when the piston is at the top end of the stroke. Combustion should begin in the center of this space and spread on all sides, and should not begin in some distant pocket or corner to slowly burn itself out and probably finishing its combustion after the exhaust pipe is opened. All engines which have made records for economy properly authenticated, etc., have been without pockets of any kind in the cylinders and have ignited at a point where the explosion could spread on all sides, somewhat as a center fire gun is fired, the charge almost detonating instead of slowly burning. The explosion of such an engine is a sharp crack, like the shot of a pistol, rather than a puff. While the engines, with pockets, may have structural and commercial advantages, although even this has been disputed, they have certainly failed in tests of economy. This is probably due to the fact that the charge is exposed to so much cooling surface at the moment of explosion, resulting in the quick collapse of the gases.

It is easy to conceive how engines without pockets, flat or domed head and cup piston form a chamber of the minimum area of cooling surface, and the explosion will show an indicator card with a higher expansion line for any given amount of fuel than with any other form of combustion chamber. This principle is not only upheld by Clerke in his "Axioms of a Gas Engine," but by ordnance experts and automobile manufacturers.

Among common forms of combustion chambers, some of the worst designs possible are as follows: First, the domed piston; a domed piston gives a shapeless combustion chamber with feather edges. The combustion will begin in some far corner of the chamber, seldom directly from the center, and spreads on all sides down into the feather edge of the piston until it is so cooled by the piston and cylinder walls that combustion cannot proceed any further and only unburnt gas is left around the piston. The same may be said of a head which is domed inwards and of pockets and recesses of any kind whatever. There probably is no more important factor of design before gas engine manufacturers to-day.

The compression of various mixtures has no effect whatever upon the subject of compression proper, but as the maximum pressure is the subject immediately succeeding compression it might be said that innumerable experiments have been made in the explosion of gases mixed with various proportions of air under various pressures with a view to establishing data; but these, like most other experiments which are not made under the operating conditions of the inside of the gas engine cylinder, are comparatively worthless to the gas engine men and better than wasting time with these purely theoretical tests it is advisable to study the many results available from actual experiments with gas engines. The same might be said about the huge, complicated and useless thermodynamic treatises upon the gas engine, none of which are accurate, however much they may assume to know what the conditions as to cooling, combustion, etc., will be within a given cylinder.

The calorific value of a fuel being known, the compression and economy being chosen with careful judgment by the designer, it is a simple and practical method for him to figure backwards from the one-eighth or one-tenth of a gallon per horsepower per hour or number of cubic feet of gas to what his charge will be in the cylinder.

To find the pressure from a given possible explosion with a given fuel it is necessary for purposes of practical design that the maximum pressure of explosion be assumed. This and other data are obtained from previous experience, together with experiments and progress.

WEIGHTS AND COST OF VARIOUS TYPES OF ENGINES.

These vary so widely that it is not possible to state them specifically without carefully classifying the various types of engines.

Taking first horizontal gas engines of large power, say 1,000 horsepower or more, of either the two or four-cycle type of the generally accepted arrangement of two double-acting cylinders arranged in tandem, together with duplicates of this arrangement acting upon the same crank shaft. These engines

complete, with bed plates, crank shafts, valve-gearing tools, pipe-fitting accessories necessary for connection with gas producer, or other source of fuel, can be purchased in Eastern parts of the United States by the best makers for about $32 (£6.6) a horsepower. This refers to engines of the highest grade, made by reputable firms. Less desirable engines of the same power are made by large firms, not specialists in the business, for as low as $26 (£5.35) per horsepower. The first-named engines in general are exclusively of American design, the styles of which will be considered later; while the latter, made by several large firms, are imported German designs.

These types are changing very rapidly from year to year, but, in general, it may be said that the speeds and compressions are increasing, the cylinders are being multiplied and the bore and stroke per horsepower reduced; while the total capacity of the units are being increased, some having been constructed as high as 6,000 horsepower.

Of the smaller power engines, from 200 to 1,000 horsepower, single and double-cylinder engines are mostly used, same being coupled in tandem; or, in the case of 200 and 300 horsepower, only single-acting cylinders with trunk piston are used. The highest grade of engines in the case of single-acting cylinders nevertheless use hollow, water-cooled piston with rod and outside cross-head in ordinary steam-engine form, the cross-head into the cylinder being wide open. Of the engines less than 200 horsepower their name is legion and their type is well known.

The typical factory-made cheap gas engine of the horizontal type, made in large quantities for use on farms, etc., with all accessories up to 10 horsepower, may be had for about $30 (£6.2) per horsepower. Above this they cost less up to 50 horsepower, at which size they are hardly made as yet in large lots by factory methods, rather being jobbed by special order. In these assortments they cost $30 (£6.2) to $35 (£7.2) per horsepower.

Some of the special types of horizontal engines which may be mentioned as well up in popular favor are the double-opposed, high-speed engines made in sizes up to 50 horsepower; very successful engines operating quietly up to 800 revolutions per minute, which makes them suitable for direct connection with generators, centrifugal pumps, etc. These engines are also made air-cooled, and in either case they may be expected to cost in the open market about $25 (£5.1) per horsepower when purchased from reputable firms.

High grade two-cycle engines, oil injection engines of the highest grade, large gasolene (petrol) engines and other types of more or less standardized horizontal engines between 50 to 200 horsepower may be expected to cost $30 (£6.2) to $35 (£7.2) per horsepower in the open market. Extremely high-grade engines, with extra finish, etc., will run up to $40 (£8.2) per horsepower.

With the vertical engines, as with the steam engine, the most highly developed type is the marine, having to develop the maximum horsepower in a limited space and limited in weight, at the same time requiring unusual wearing qualities, reliability, economy and reasonable cost, thereby putting a heavy task upon the designer. The inevitable result has been a vertical high-speed multi-cylinder, short connecting engine, usually of the single-acting type, although the double-acting type is rapidly growing into favor.

Those engines in which the mixture is prepared outside of the cylinder have been adopted as best meeting the requirements. The two-cycle is cheap and in a wobbly, uncertain manner reversible. Its usfulness, so far as a hard-working motor is concerned, is not great, but it makes a very excellent pleasure engine, because of its lighter complication and the fact that it can receive considerable attention without delaying important affairs.

The vertical stationary engine has been very much affected by the development of the marine type, if, indeed, it does not spring from it. This type of engine is as much of a factor in large power production as the horizontal type. While not yet developed in as large units, it is perfectly capable of so being and can, in every way, accomplish the same results as the more cumbersome horizontal engine with less initial cost and with a higher speed, more suitable for modern machinery, occupying less floor space and being under less cost of maintenance. Small vertical engines of the highest grade for marine purposes with reverse gear up to 10 horsepower may be purchased in the open market for about $75 (£15.4) per horsepower. From 10 to 20 horsepower they greatly drop in value to about $40 (£8.2). From 20 to 50 horsepower their value again decreases to about $30 (£6.2) per horsepower, which is as cheap as high grade engines can be purchased. Factory-made engines can be purchased for 40 percent less, but there is no factory-made engine available to-day which can stand up to the marine work at hard going every day in the year under conditions of rough water, ice, snow, lack of attention, etc. This same type of engine, arranged for stationary purposes, will cost as a rule about 20 percent less. The weights of engines per horsepower will run about as in the following table.

TABLE 6.

Horizontal.

Stationary.	Weight.
	Pounds.
Large tandem constructed of the heaviest type 500 H. P. and over	280
Same construction, 500 H. P. and under	260
Standard type gas engine, 50 to 100 H. P.	200
Standard type gas engine, less than 50 H. P.	240

Gas Producers.

Small	350
To 50 H. P.	160
To 100 H. P.	100
To 1,000 H. P. and over	75 and even 50

Vertical.

Marine Type.	Weight.
	Pounds.
Single cylinder, less than 10 H. P.	188
Double cylinder, less than 20 H. P.	210
3-cylinder, less than 50 H. P.	210
3-cylinder, 50 H. P. upwards	195
4-cylinder, less than 20 H. P.	110
4-cylinder, less than 50 H. P.	110
4-cylinder, 50 H. P. upwards	122
6-cylinder, same as 3-cylinder	

The cost and weight of gas producers for engines vary somewhat, depending very much upon the installation, but, in a general way, for less than 1,000 horsepower for almost any size installation, the cost of producer plant complete, with scrubber, etc., will not be far from $10 (£2.1) to $12 (£2.5) per horsepower.

(To be continued.)

Unofficial reports regarding the new Hamburg-American transatlantic steamer originally called the *Europa,* but now named the *Imperator,* state that the vessel is to be fitted with forty-six watertube boilers of a modified Thornycroft type. Propulsion is by four modified Parsons turbines, and the ship is to be fitted with three funnels, two of which are used for boiler draft and one for ventilation, so that all ventilating cowls are dispensed with. The exact dimensions of the *Imperator* have not been announced, but it is known she will be approximately 900 feet in length. She will have a beam of 96 feet and a gross tonnage of 50,000. A crew of 1,000 will be required to run the great ship, and her cabins will accommodate 4,250 passengers. Her engines will develop 70,000 horsepower.

THE LOCATION AND DISPOSAL OF DERELICTS.

BY STANLEY V. PARKER.

(*Concluded from page 409*)

The disposal of derelicts depends largely upon their condition when found. It is the general opinion that if possible, the vessel should be towed into port or beached. This would seem to be true, because the derelict is generally of some value, and it is doubtful if a vessel well held together can be so wrecked as to make her fragments harmless without an excessive expenditure of explosive. The disadvantage is the added labor of getting her into port involved, as the derelict generally offers some considerable resistance to towing and the expenditure of coal and lines, but it would seem that,

WRECKING A DERELICT WITH MINES.

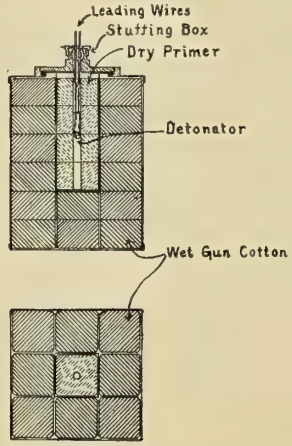
if the vessel were of any real value, the owners or underwriters would gladly pay for the expense of getting her back.

From statistics, the destruction by fire in the case of wooden vessels seems to have been very satisfactory; destruction of floating wrecks by explosives has been so little tried, and therefore so little experience has been had with it, that of its value and difficulties little of real value can be said, and destruction by ramming is in about the same category. What will here be said about the disposal of derelicts will refer to wooden vessels unless it is otherwise stated.

During the period of 1887 to 1893, 41 derelicts were towed into port, but there is no account of the experiences and difficulties encountered by the workers. Since that time many more have been towed in, but the lack of reliable information in regard to them prevents any exact consideration. We can well consider the condition of the derelict as affecting the methods employed.

In the case of a vessel with steering gear intact, a good sized hawser should be run into the derelict in order that we be not disturbed at night with a parting hawser. One of 9 or 10 inches would serve the purpose well. We may place our faith in a 6-inch line only to have to run another at one a. m. with a nasty sea to complicate the operation. The size of hawser is necessary because usually the derelict is waterlogged and offers a great deal of resistance to towing. The hawser would well be made fast to the foremast near the deck and lead to the towing vessel through a chock, being protected in the wake of chock, bobstays and other head gear by parceling or other chafing gear. A party should be sent aboard the tow to watch and steer, and the regulation lights should be provided. The party should be provided with a boat to be towed astern of the derelict with sails, signal flags, lantern, food for several days, water, axe, marline spikes, seizing and small stuff, heaving lines, life preservers, etc., in fact, everything that would be absolutely necessary if the party should be cast adrift. Otherwise the tow would not require any other than the usual towing methods.

If the steering gear is disabled beyond repair, time permits and the decks are habitable, an improvised jury rudder will save much wear and tear on the nerves of the people on the towing vessel. The hawser would be secured as above de-



UNITED STATES NAVY WRECKING CHARGE.

scribed. If the rudder could not be rigged the hawser should be secured to the tow with a span to prevent her yawing, and it has been generally preferred to towing stern first. Towing such a vessel without a span results in her taking violent sheers alternately from side to side, and I have seen such a tow actually come up abeam on either side of the towing vessel, endangering the line, racking the tow and making speed absolutely impossible. It would be a wise provision to have such a span on board the vessel as a permanent part of her outfit, ready for use at a moment's notice. It should be provided with plenty of end for taking turns or for lashing, and should have a form of thimble at the V that would prevent chafe on the line. In addition a drogue to be secured on the after end of the tow might be of assistance, and this should also be a permanent part of the outfit. These items should be kept on hand, because in the haste and confusion of making fast we are simply wasting valuable time if we stop to make spans and drogues; oftentimes we will have to seize an opportunity while a sea is making up before it becomes too rough for boating. If we are not so provided we shall have to depend on a single line, and it is well nigh impossible to break such a tow's sheer without parting the hawser, and meanwhile we are working to port at the speed of about 2 knots. It will likewise here be advisable to keep some men aboard the tow if the decks are habitable and the weather is not severely cold. If the vessel's steering gear is jammed over beyond hope of repair we might blow it away. If this is impossible we shall possibly have

difficulty in spite of the span. A vessel towed astern of the derelict would straighten her up, but, generally, we have no other vessel with us.

If the vessel is bottom up we must find some place to make the line fast, and several ways of securing it suggest themselves. If we can get a man aboard her with tools we can cut out a section of the keel about a foot in length. Into this would be dropped a bowline on our line, and a heavy plank would be spiked across the channel. The hawser, of course, would have to be protected from chafe, and the heaviest line on board used, as we will have a heavy tow.

A heavy wrought iron shackle, to be secured to the keel or bottom of a capsized vessel, has been designed and tried. Weighing 200 pounds, it is rather difficult to handle from a small boat, but that it is practicable in some cases has been demonstrated. Built in sections it might be more readily handled.

Another scheme that has been suggested consists in boring a hole in the keel of a vessel by firing a shell through it. This

A DERELICT THREE-MASTER THAT WAS TOWED TO PORT.

has been tried with a 6-pounder; but the wood being more or less spongy the hole closed up quickly after the passage of the shell. If we are successful we can reeve our line through the hole, or better, provided with an iron or steel bar, insert it in the hole and secure the line to a shackle made fast to the bar. A vessel on her beam ends would nearly always afford some place to which we could secure a line.

In towing steel vessels the same general methods above described would be used except those relating to capsized vessels. A steel vessel on her beam ends would rarely be met with. If battened down she would present no insurmountable difficulties, and the value of such a vessel would undoubtedly lead us to use every effort to get her into port.

A steel vessel bottom up would indeed be a curiosity, but vessels in such a condition have really been known of. To tow her by securing a line to her rudder post or shaft might be feasible.

The resistance to motion through the water increases so rapidly with the increase in speed that we need not expect to be able to make very great speed with our tows in their usual condition—waterlogged or capsized. We should, as said before, use our heaviest line. If under those circumstances we wish to compute the strain on the line for certain speeds we would not find it a monumental task to do so roughly, but undoubtedly most of us would rather rely upon our judgment.

A TYPICAL DERELICT.

These capsized vessels could only be taken into certain depths, of course.

The destruction of the derelict should be given considerable thought. The advisability of its partial or complete destruction by fire should be considered, and if practicable should certainly be adopted. A vessel in ballast burned to the water's edge would certainly sink. In case we do not complete the destruction by fire we can use explosives to finish the work. Statistics collected from 1890-1893 show that of seventy-six derelicts set on fire seventy-two were thereby destroyed.

The attempt to destroy the *Fannie E. Wolston* by fire failed because she was so badly waterlogged, and it would generally be difficult to destroy by fire a vessel in her condition. However, in a good many cases if it were feasible to start a hot fire with the assistance of kerosene (paraffin), even though

A DERELICT PARTLY DESTROYED BY FIRE.

slightly waterlogged, we might accomplish our purpose, as the wood of the parts near the flames would be prepared for the fire by its heat. In the case of a partially successful attempt to destroy by fire, as said before, we could resort to explosives to complete the destruction. In fact, in some cases we would be compelled to use it from the first. The most obvious question then is, "What explosive shall we use?" and the natural answer would be "The most violent." But safety in handling and storage plays an important part, and the explosive must be unaffected by water, or at least its receptacle should exclude the water if not. The high explosives, together with black

powder, in the order of their explosive strength, are as follows, the standard being nitro-glycerine, 100:

Explosive gelatine	106.17
Nitro-glycerine	100.00
Gun-cotton	83.12
Dynamite No. 1	81.31
Rackarock	61.71
Picric acid explosives	50.82
Black powder, fine	28.13

Explosive gelatine is then the most violent of the high explosives; in fact, it is so violent that generally some other substance is incorporated with it to reduce somewhat this violence. It is composed of a mixture of nitro-glycerine and a nitro-cellulose completely soluble in ether-alcohol. In its camphorated form it is comparatively insensitive to shock except when frozen, and then it is extremely sensitive and dangerous. As nitro-glycerine and its mixtures ordinarily freeze at about 40 to 45 degrees F. their use on board ship, where, at times of the year we commonly experience such temperatures, would not be advisable.

Nitro-glycerine is next on the scale, but on account of its sensitiveness, its high freezing point, and the danger of its leakage unnoticed, it is eminently unfitted for stowage on board ship.

We now come to gun-cotton. It is highly nitrated cellulose (insoluble in ether-alcohol). Its great value depends on the fact that when wet it is comparatively insensitive to shock, and can only be detonated by the explosion of dry gun-cotton in contact with or quite near it. As we can dry the cakes of wet explosive as we need dry primers (there being but 25 percent moisture in them) we need have no large amount of dangerous explosive aboard except when actually engaged in its use. The value of gun-cotton has long been recognized, and it is a standard military explosive, being used in mines, torpedoes, wrecking charges and in the field for the destruction of structures and material. In handling the explosive it is essential in submarine blasting that its form be convenient and that the dry primer be protected from the water. The standard navy wrecking charge is constructed as follows:

A sheet copper or sheet iron case, rectangular in section, tinned inside and out, 12⅜ inches long and 9 inches square inside, is the receptacle for the explosives and the primer case. The primer case, fitting inside the outer case, is 8⅛ inches long by 3 inches square inside, and is closed at one end. In the sheet iron mine it is of tin, in the copper mine of copper. Around the filling hole of the large case at the top is soldered a brass ring with a flange, and this flange is threaded for the reception of a brass cover. In the assembled position the flange of the primer case seats on a rubber washer inside of the flange of the brass ring. The screw cover screws down over a rubber washer over the primer case flange, thus making a watertight joint around the circumference. A boss on the center of the cover plate provides a screw seat for a cap and a peculiar form of stuffing-box is formed in it by the insertion of a rubber ball, drilled through in two places for the entrance of the leading-in wires.

The large case is filled about the center with eight piles of six cakes of wet gun-cotton each, making a total of 48 wet blocks, and to this is added two wet blocks placed in the center under the bottom of the primer case, thus making in all 50 blocks of wet gun-cotton. These blocks are 2.9 inches by 2.9 inches by 2 inches in size.

Between the piles of blocks on the sides and over the two blocks in the center the primer case is inserted, its flange resting on the washer inside the brass cover ring. This case contains a single pile of four dry gun-cotton blocks, each block bored out in the center so that a continuous central channel leads from the top to the bottom of the pile. The detonator, a fulminate of mercury electric exploder, is inserted in this channel, and its wires are spliced to the leading-in wires, so that the splice will be inside the case, the leading-in wires having first, of course, been led through the holes in the ball packing. The cover cap confines the ball, compresses it, and makes a watertight joint about the leading-in wires. The mine loaded weighs from 50 to 60 pounds. For firing it a battery of electric cells or a form of Farmer's machine, a small, handily operated but powerful magneto, are commonly used, and a standard insulated cable is used in connection with it.

The method of handling the mine and the number to be used depend on circumstances. The suggestion for using wrecking outfits, contained in the naval ordnance pamphlet No. 343, December, 1905, says:

"So long as the unit mine charge is large enough to cause disintegration of the wreck in its immediate vicinity, it is better to distribute such units at different important points rather than to group them at one spot. It has been found, however, that a single mine charge is rather light for isolated use, except with very weak structures, and ordinarily the use of more than one at any given spot is advisable. Good judgment on the part of the officer ordering the arrangements is necessary.

"The mines should be submerged as much as possible and placed under the wreck, as the explosive effect is greatest in the direction of least resistance, which is usually upward. As the destructive effect of a charge of gun-cotton upon a body decreases proportionately to a fairly high power of the distance of the center of gravity of the mine from the body, it is necessary that the mine be held as close as possible to the part of the wreck to be attacked.

"In dealing with lumber-laden wrecks it is well to blow off the upper decks, so as to allow the cargo to float out, as little can be done toward destroying the wreck so long as the cargo remains intact. If she be a floating derelict the deck should be sufficiently destroyed to allow the lumber to float out, and then the bottom sufficiently damaged to sink her.

"A mast can easily be removed by exploding a mine near its base."

The direction in regard to submerging the mine is of considerable importance. The water acts as a tamping and prevents the excessive radiation of the explosion in all directions.

If we could determine in what part of the ship the explosion would have the greatest effect on weakening its structure we would be able to work intelligently at it. The destruction of the deck beams would wreck the parts of the structure which hold the sides together, and this would seem to be a very much desired result. It might be of value in some cases, but the general opinion is that once the bow and stern have been wrecked we will have very little trouble with the rest of the structure. A combination of the two ought to give good results when we are so situated as to be able to use them. The use of a number of mines in series would facilitate the destruction in this case.

A line of mines under the keel athwartships at each end of her could be placed with the assistance of sweeps such as are used for placing collision mats, and their explosion at the same time in series would undoubtedly rack the structure greatly, and probably would remove bow and stern. The further destruction of the hulk could be accomplished by running with a series of hogging lines a number of mines along her keel to be exploded in series at the same time. Of course, the expenditure of explosive would be considerable, but to destroy a derelict that was in good condition and strongly held together could not be accomplished without this expenditure. Generally such a vessel would be towed into port or first burned. In any case, placing the mines *under* a vessel would place the mines in an advantageous position and provide

them with a magnificent water tamping. The fragments of the vessel, if large enough to constitute a menace, could then be treated separately.

A vessel capsized presents a rather difficult problem. We can treat her as we have just described for a vessel in her normal position, provided we can get our mines close enough up under her to get them near the decks. This would be complicated by the difficulty of getting lines under her jibboom and past her masts. As to the first objection, when we consider the magnificent tamping that the mines will probably have, the effect of the explosion will not be so very slight, and as to the second, in good weather, one such line could be got under her forecastle by letting two boats with a leaded sweep between them pull down from ahead of the derelict and others by pulling from astern. Our mines would be hung from this line. If we are unable to get the mines under her, it becomes necessary to get them inside of her, but exploding gun-cotton inside of her without the fine tamping before mentioned would be a poor substitute for the first method. The expedient of firing a high explosive shell into the derelict has been suggested, and with a 5-inch gun firing such a shell we could easily make holes in her bottom, and in bad-boat weather pretty well destroy her with several shots.

Ramming might be resorted to at first to rack the derelict, but it would hardly be wise in most cases, unless our destroyer was particularly strengthened forward. Small vessels would ordinarily be too lightly built to attempt seriously such an operation. However, if our bows are strong enough to resist the shock, ramming would undoubtedly greatly weaken the derelict and start the work of destruction.

What has just been said refers to wooden vessels, and the destruction of floating derelict steel vessels would probably present no necessity for the use of explosives except for blowing a hole in a compartment or in her bottom. They would naturally be towed into port.

STRANDED WRECKS.

If a stranded wreck has six or seven fathoms or more water over her decks it will generally be sufficient to remove her masts. As the directions before mentioned state, it will be accomplished by exploding a mine or mines at the partners. This is not always as easily accomplished as we might expect, as the vessel may be lying in a swift tide way and her yards and gaffs may still be in place, and it consequently is difficult to land the mine where needed. The use of a grommet of chain or cordage will be of assistance if the mast is clear of yards and gaffs; if it is not, we shall have to do the best we can, lacking the services of a diver. Except in bad swells a diver would be of incalculable value. It will generally be unnecessary to cut the rigging of a vessel, as it will be parted by the jump of the mast. The explosive should be handled preferably from a ship's boat, and the boat should be clear of the wreck at the time of the explosion. The mines are secured to the lines by slinging them with small stuff, and they should not be handled by the leading wires; a small bight of these should be strapped to the boss of the mine's case, so that no strain will come on the stuffing-box. If the vessel is in such a position that her hull itself is in the fairway, and there is not water enough over her to allow vessels to pass, we shall have to destroy the hull also, and here the plan of blowing off stern and bow first would be used. By the time her stern, bow and masts were gone, more mines could reasonably be expected to totally wreck the vessel. If then the fragments are a menace we should have a lighter equipped with stout derricks to get them out of the way. Here again we would need a diver. If the current is bothersome or dangerous to the diver we can well postpone our operations to slack water each day.

ANNUAL MEETING OF THE NAVAL ARCHITECTS' SOCIETY.

The nineteenth annual meeting of the Society of Naval Architects and Marine Engineers will be held Nov. 16 and 17 at the Engineering Societies' building, 29 West Thirty-ninth street, New York. The usual banquet will take place on the 17th, and a notable feature will be the presence of the society's distinguished honorary member, Sir William White, who will be presented with the John Fritz medal by representatives of the societies of Civil Engineers, Mechanical Engineers, Mining Engineers and Electrical Engineers.

Shipbuilding in Scottish Yards.

According to the Glasgow *Herald* there has been a slight falling off recently in the tonnage of new shipbuilding contracts, and the orders reported during September were considerably fewer than the monthly average for the year. It is stated, however, that more large cargo steamers have been ordered from Clyde and Northeast Coast yards than have been made public, and the activity in most of the marine engineering works seems to indicate a continued demand for high-class propelling machinery. There is no decrease in the production of new tonnage. The output of the Clyde yards during September was thoroughly satisfactory, and the total for the nine months shows that the year will take at least third highest place in tonnage statistics up to date. The trouble with the holders-on has passed meantime, and it is believed that arrangements will be made whereby stoppages of work of that particular kind will be obviated in future. Freights continue fairly good, and the number of idle vessels is small. The large tonnage which has been completed this year has nearly all found employment, and owners are still willing to take delivery of new ships as early as builders can manage to hand them over. The great majority of the berths in the yards are occupied, but the recent advances of wages and the low price at which contracts have to be booked are keeping profits at a low level.

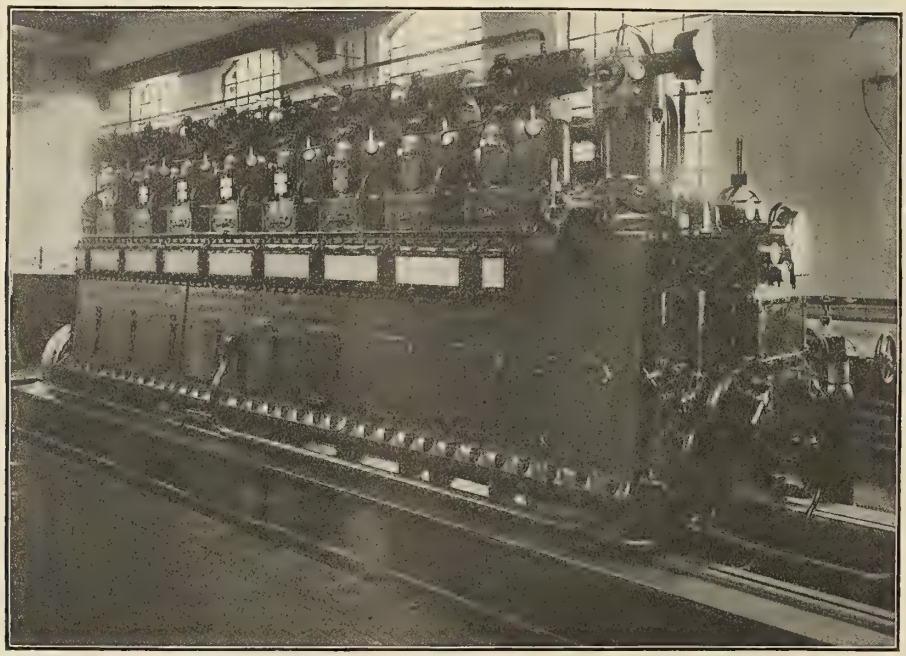
NLSECO OIL ENGINES.

In the May and October issues of International Marine Engineering brief descriptions were published of the type of Diesel oil engine developed by the Maschinenfabrik Augsburg-Nurnberg Company of Germany. This engine is now being placed on the market in the United States under the name of the "Nlseco" engine by the New London Ship & Engine Company, Groton, Conn. These engines are single-acting, working on the two-stroke cycle with combustion of the liquid fuel under constant pressure. On the up-stroke of the piston, air is compressed in the working cylinders to a high-pressure, and shortly before the end of the up-stroke a spray valve opens and oil is injected into the cylinder. The high temperature of the compressed air ignites the oil and causes combustion, which during the first part of the down-stroke takes place under constant pressure. During the latter part of the stroke the products of combustion operate the engine by expansion. At the end of the working stroke the burnt gases are exhausted through ports uncovered by the piston, and the cylinder is scavenged by pure air supplied by a scavenging piston.

The cylinders are water-cooled, and the pistons are also cooled by special arrangements to avoid any danger to lubrication in case of leakage. The wrist pin, or gudgeon pin, is placed well below the hot portion of the cylinder, being placed

in the scavenging piston which, besides supplying the scavenging air, serves as a crosshead to relieve the working piston of any side thrust. Forced lubrication is used throughout the engine, the system serving to cool the main crank-pin and wrist-pin bearing, as the oil is used in a closed circuit and cooled by a suitable cooler.

marine work, other items than the fuel economy must be taken into account. In general, oil engines have been found to save something like 40 to 50 percent in the weight and space required for the machinery and fuel, offsetting the slightly greater first cost of the installation and affording increased carrying capacity and earning power of the vessel.



LIGHT-WEIGHT, HIGH-SPEED, 850-HORSEPOWER NLESCO ENGINE.

The fuel is injected into the cylinders by compressed air furnished by a two-stage air compressor driven from the crankshaft. This compressor has a capacity in excess of the fuel injection requirements.

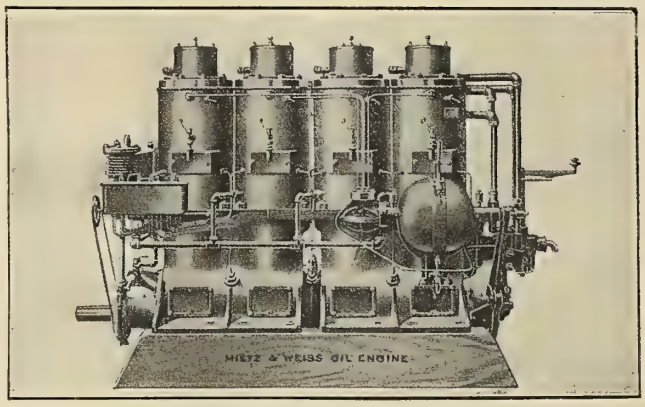
The control gear of the engine is located at its forward end, and is so arranged that the operations of starting, stopping, reversing or changing speed are all accomplished by the simple movement of a hand lever or hand wheel, which, with the necessary gages, speed indicators, etc., is grouped at this station, so that the operator can keep posted on the various conditions affecting the working of the engine.

These engines are usually made in six-cylinder units, which are found to give good balance and freedom from vibration as well as a very uniform turning moment without the necessity of using a fly-wheel. The scavenging and fuel valves are mounted in cages, so that they can be easily removed for examination and ground in when required.

The most important points about any marine engine involve a consideration of the final economy of the engine. In the case of the oil engine remarkable results are given for the actual fuel consumption per brake-horsepower per hour. In the case of the "Nlseco" engine, a fair average fuel consumption is said to be .5 pound per brake-horsepower per hour, this figure varying slightly on account of the size and speed of the engine, being lowest for large and slow-speed engines and a little higher for small and high-speed engines. The average price of such oil in the principal seaports is 3 cents a gallon, and reducing the figures for fuel consumption to cost the average fuel cost is found to be .2 cent per brake-horsepower-hour. This, if compared with the cost of gasoline (petrol) or steam power for similar installations, shows a great advantage for the heavy oil engine, as far as fuel cost is concerned, the cost for gasoline (petrol) being about seven and one-half times as great and for steam about two and one-half times. In comparing the different forms of motive power, however, for

MIETZ & WEISS OIL ENGINE.

A 75-horsepower, three-cylinder oil engine is being installed in a commercial motor boat, 56 feet long and about 12 feet beam. This engine, which is manufactured by August Mietz, New York, is a reversible engine coupled directly to the propeller shaft. It is of the vertical type, with cylinders 10 inches diameter by 12 inches stroke, running normally at 340 revolutions per minute. The speed can be reduced to 80



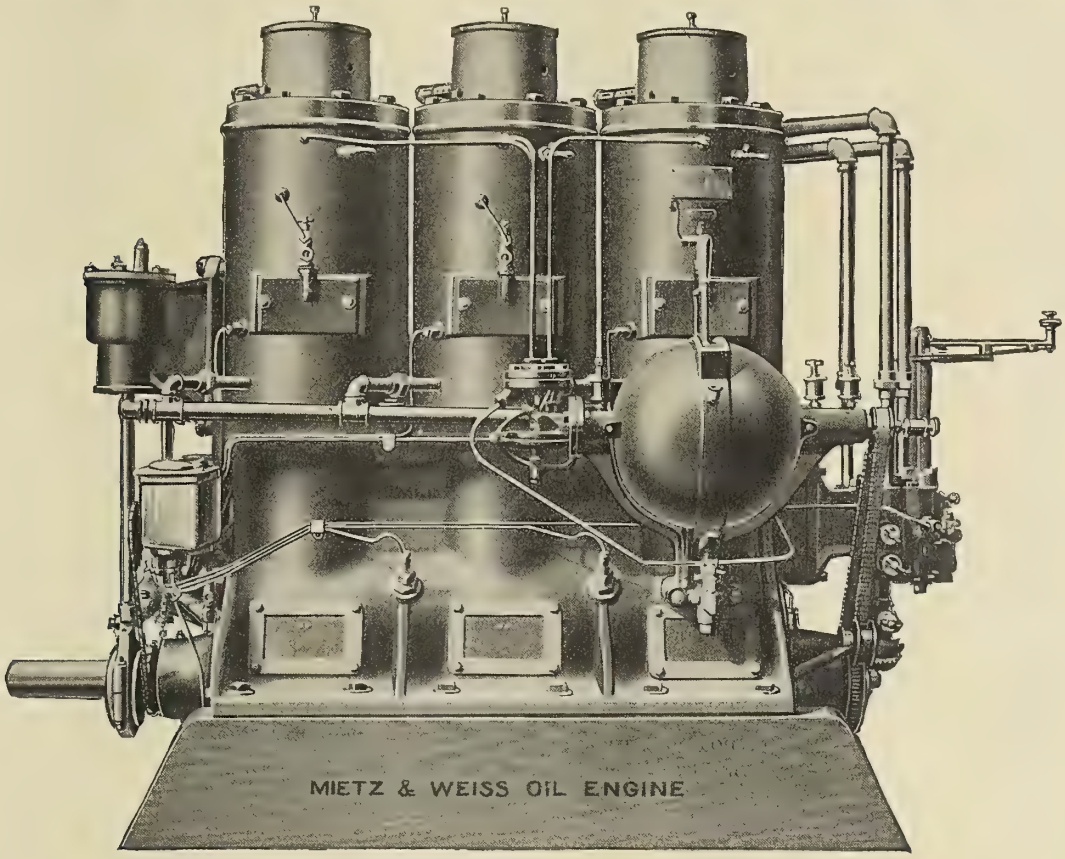
FOUR-CYLINDER MIETZ & WEISS OIL ENGINE.

revolutions per minute for constant running, so that the boat will be kept barely moving. There are two large air tanks and one emergency tank in the engine room, which are usually kept up to a pressure of 175 pounds per square inch by a small air compressor attached to the rear cylinder of the engine and operated by an eccentric from the main shaft. There is also a small auxiliary compressor, which is operated by a 2-horsepower Mietz & Weiss vertical oil engine, but this is

intended to be used only in exceptional cases, whenever the air pressure should fall below 65 pounds, or for the initial pumping up of the tanks. With this air storage compressor, it is claimed the engine can be started and reversed from ten to twenty times, and when the engine is running full speed ahead it can be reversed full speed astern in less than seven seconds.

Ordinary oil fuel is used for this engine, costing in New York harbor about 3 or 4 cents per gallon. The fuel consumption is said to be not over .9 pound per horsepower-hour at full load, so that for constant operation at full speed it would require 75 gallons of this oil for a ten-hour run, which, at 4 cents per gallon, would bring the cost of fuel to $3 (£0.615).

In accomplishing reversal of the engine in this way there is one feature which requires particular attention, and which is very important in this type of engine: the fuel oil which is supplied to the cylinder under pressure by a small plunger pump under direct control of the governor, must be controlled in such a way that no oil will be injected into the cylinder during period of reversing the direction of rotation of the engine, but also just as soon as the engine has started in its rotation in either direction the oil must be immediately and automatically injected. For this purpose there is arranged at the lower projecting end of the rotating valve, where it is driven by a bevel gear from the main shaft of the engine, a pinion driven by a friction collar. This pinion engages in a



THREE-CYLINDER MIETZ & WEISS OIL ENGINE.

The reversing mechanism of the engine is known as the S. & W. distributor. It consists of a rotary valve with positive drive from the main shaft of the engine, controlling the flow of air from the air pressure tanks to the cylinders in proper order for rotation of the engine either ahead or astern, under control of the lever at the front of the engine. In the casing in which this valve rotates there are cored as many ports as there are cylinders in the engine. Each cylinder is connected by a pipe to its port in the valve casing. The valve is made with a single partition, for the purpose of directing the air to the cylinder for rotation in either direction. Directly in front of this rotating valve is the hand lever-controlled valve to which the air flows from the tank. This lever valve is also made in two sections, for the purpose of directing the air to one or the other section of the rotary valve for running the engine either ahead or astern. The controlling lever moves over a segment, to which it can be locked by a spring bar extending to the handle of the lever. When the handle stands in the central position the air is shut off entirely; when it stands in the extreme right-hand position the engine runs ahead, and in the extreme left-hand position the engine is reversed.

segment which carries a cam acting on the stem of a small by-pass valve. The first movement of the hand lever throws this segment in a central position. The segment is locked and no oil can pass into the engine. A further movement of the lever unlocks the segment and allows the air to start the engine, and immediately the frictional pinion carried on the projecting end of the rotating valve moves the segment to one side and closes the by-pass and then the oil is pumped to the engine. This takes place for rotation in either direction.

This oil-controlling action with a reversing mechanism is claimed to provide an absolute control of the oil, and is, of course, of great importance. If there were no such control the oil could be injected immediately on starting the engine in either direction, and there would be an explosive mixture at the start of the compression stroke of the piston at tank pressure, which is generally about 175 pounds per square inch. The compression pressure in the engine being about 100 pounds per square inch, this would bring the internal pressure up to over 1,500 pounds per square inch, and the explosion pressure which follows would be approximately 4,500 pounds per square inch, which is considerably higher than the highest normal pressure which is ever obtained in these engines.

LETTERS OF INTEREST FROM PRACTICAL MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

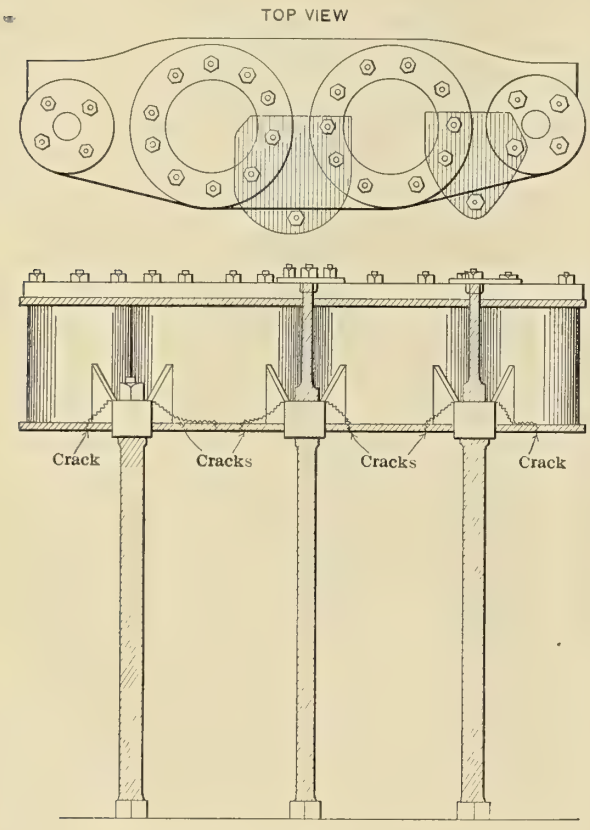
Repairs to a Jacking Engine.

EDITOR INTERNATIONAL MARINE ENGINEERING:

The accompanying sketch gives an idea of a breakdown to our starboard jacking engine and how it was repaired:

The lugs by which the cylinder casting is secured to turned columns broke through, as shown by dotted lines, which left the front part of the engine without support. The cause of breaking were flaws in casting and water in cylinder. The engine was 5 inches by 7 inches, with two cylinders and two piston valves.

After breaking the engine could not be used. The worm was in gear, we were going out next day and the worm



FRACTURES IN STARBOARD JACKING ENGINE.

could not be removed without running the jacking engine. A hasty repair job was started and completed within eight hours.

As will be seen by the drawing, the nuts on top of columns were removed and extensions put on columns, similar in appearance to socket wrenches, but with the lower ends tapped for threads on the column. Plates of ½-inch iron were gotten out of such shape as to permit bolting to the cylinder heads by use of longer studs, and to receive the top end of the extensions, with a nut above and below the plates. The engine was then warmed up and the top nuts secured. Then the bottom nuts were screwed up tight. This took care of expansion. The job has been installed six months and is as good as a new engine.

All three lugs broke and were repaired this way, but only two plates and extensions are shown, while the third shows the original form.

G. C. ELLERTON,
Ft. Munroe, Va. Chief Machinist, U. S. N.

Trouble on an Oil Tank Steamer.

EDITOR INTERNATIONAL MARINE ENGINEERING:

An engineer, invested with the responsibility of one of the vessels of sorts that go kicking about the world in the happy-go-lucky style that belongs to the boats of the smaller owners, is sometimes tempted to cast the eye of envy at the little tin gods in smart uniforms that entertain the ladies on the liners when they are not toying with a spanner. The difference is marked, but if experience is anything it is pretty safe to say that the man who has to get through as best he can gets the experience in chunks. As an example of the way the engineer has sometimes to get a move on his wits, the following little anecdote about trouble on an oil tank steamer may be interesting.

On one occasion it was discovered that the line between the pump room and the forward tanks on the boat had become holed. Of course, these pipes should not have been made of cast iron, but they were, with the result that they became corroded until a hole was formed. This was only discovered when it became necessary to pump the forward tanks out. Naturally the pumps would not draw the oil because the vacuum in the pipe line was lost; the forward tanks were nearly empty, there being only about 3 inches of oil left in them, but it was, of course, necessary to get the remainder of the oil out.

As the tank in which the damaged pipe was situated was full of gas, no one could venture to go down in order to stop the leak. The oil depot manager, however, was anxious to get that oil and get the ship away, so that he rose to the occasion by offering $35 (£7) to anyone who could stop the leak. An engineer on the boat thereupon had a brain-wave and got those dollars as follows: On the ship there happened to be a football for which there were two bladders. The engineer secured those two bladders and pumped them both full of ordinary air. He tied a piece of string round the cock of one bladder and held the other one in his mouth. He also provided himself with a clothes pin and secured this firmly to his nose. Previously to attending to his own personal appearance in this manner he had got a piece of canvas and smeared it thickly with white lead, and also a ball of marline. When all was ready he got some helpers to lower him quickly by means of a sling down to the bottom of the tank. The pump had been kept going so that the engineer soon guided himself in the dark to the place where he heard the whistling sound of the air being sucked into the pipe line. He now and then allowed himself to inhale the air from the football bladders and kept himself going long enough to fasten the canvas round the leak. When this was done he was quickly hauled up to the deck again, none the worse for going into the tank. Everybody on board, however, thought that he had earned that $35 (£7). The ship was soon pumped dry again after the leak had been stopped and was able to get away from the depot.

In the writer's opinion it ought to be compulsory for every vessel having holds in which foul gas can accumulate, especi-

ally such as in oil tank steamers, to carry a set of self-contained breathing apparatus, such as are now made by several well-known firms. Anyone who has been "gassed," even slightly, will know that it is not a nice experience and can be easily carried too far. Some of these sets are quite light to wear and give enough oxygen to allow a man to work freely for an hour if necessary; and some of them are suitable for immersion under water, which is an advantage of first-class importance under some circumstances in marine repair work.

Pennsylvania. C. B. S.

Repairing a Broken Low-Pressure Cylinder at Sea.

Editor International Marine Engineering:

We were on a voyage from Hong Kong to Kobe, with about 4,000 tons of general cargo for that port. The engines of the steamship "A——" were running at full speed, and all of a sudden a loud report was heard in the engine room, followed by the engines coming to a sudden stop. The engineers made an external examination, but could find no clue to the trouble; so we lifted the low-pressure cylinder cover, and then we discovered a hole in the side of the cylinder measuring nearly 4 feet square. We also found all the broken pieces of metal on the top of the piston.

As the cylinder was surrounded by an outer shell, forming a steam jacket, it was decided to attempt a temporary repair, and we made it in the following way:

Seven pieces of wood, 6 inches wide by 2 inches thick, were firmly wedged together; their faces were planed flush with the cylinder wall. The wood was drawn hard up with bolts to the jacket wall, and hard wood strips were fitted and screwed to the wood, so that they came in contact with the piston. We occupied eleven hours in making the repairs; we replaced the cover and set the engines away at slow speed. Everything about the repair proved very satisfactory and enabled the vessel to reach port without any further accident. When we reached port a new cylinder was fitted.

Camden, N. J. F. J. S. N.

Indicator Cards from Triple-Expansion Engine.

Editor International Marine Engineering:

The accompanying reproduction of indicator diagrams and data relating to same came to me recently. As these represent the average practice in triple-expansion engines in the mercantile marine, I thought they might interest your readers. A careful study of the diagrams taken in connection with the data given should prove of value to marine engineers in charge of similar work, and also to students of engineering who are taking special interest in steam distribution in multi-expansion engines. The name of ship, port of departure, etc., are immaterial to the abstract study of the diagrams, so I omit them.

I would like to have the opinion of those who may be interested in such matters concerning the distribution of power in the three cylinders. Should not the low-pressure cylinder, if any, develop a little more power than either of the two others? Is there any good reason why the high-pressure should develop more power than the intermediate and low-pressure? Here is the log:

Boiler pressure	180 pounds.
Vacuum	23½ inches.
Revolutions per minute	58.1

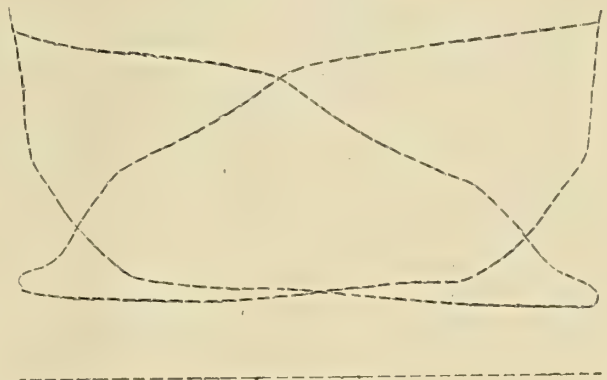
Expansion adjustments:

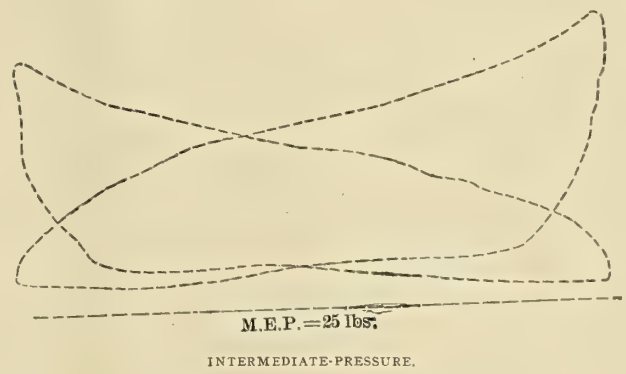
H. P., 27 inches; I. P., off;* L. P., off.*

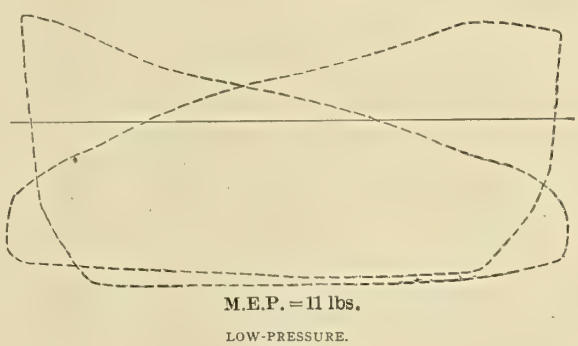
Temperature of sea-water	84 degrees F.
Feed-water to boilers	220 degrees F.
Water in boilers	379 + degrees F.

* No cut-off other than lap of valves.

Revolutions in 23 hours 42 minutes	81,920
Distance run by the engine in knots	283
Distance run by observation in knots	245
Slip of propeller, 18.4 percent; per hour.	10.34 knots.
Coal consumed in 23 hours 42 minutes	38 tons.
Clinker and ash	137.31 cwt.
Percentage	18.1







Engine dimensions:

High-pressure cylinders	28 inches.
Intermediate-pressure cylinders	46 inches.
Low-pressure cylinders	75 inches.
Stroke	48 inches.

	M. E. P.	I. H. P.
High-pressure diagrams	80.5 lbs.	737.18
Int.-pressure diagrams	25.0 lbs.	584.35
Low-pressure diagrams	11.0 lbs.	684.4

Total indicated horsepower	2,006 +
Coal consumed per horsepower-hour	1.69 pounds.
Mean immersion of ship	23 feet.
Sea	Smooth.
Time out of drydock	Two months.

Scranton, Pa. Charles J. Mason.

REVIEW OF MARINE ARTICLES IN THE ENGINEERING PRESS.

Ships.

Hudson River Day Line.—A very brief description of some of the best-known ships of this famous line, from the *Mary Powell,* built in 1861, to the *Hendrick Hudson* in 1906, the *Robert Fulton* in 1909, and the *Washington Irving* now building. In the general regard of the traveling public none has been more popular than the *Mary Powell,* though the later boats are larger and more elegant in appointments. Illustrated; 1,500 words.—*The Marine Review,* September.

The Electric Arc.—An experimental vessel built by McLaren Bros., of Dumbarton, to demonstrate the efficiency of electric reduction gear for use between a fast-running engine and a slow-running propeller. The boat is 50 feet between perpendiculars, 12 feet beam, with 4 feet 6 inches draft, with 6-cylinder 45-brake-horsepower Wolseley gasoline (petrol) engine, driving a 3-phase alternating-current dynamo. Current from this goes to motor connected direct to propeller shaft. The exciter is direct current, and is driven by belt from main shaft. Both motor and generator have two different sets of windings, giving different number of poles in their circuits. By varying the combination of these working together different speeds are obtained. Control is accomplished by means of two simple switches. A series of trials has shown the equipment to be a success both for running and for maneuvering; switch can be changed instantly from full ahead to full astern without danger of injury to the machinery. Article shows drawings of general arrangement, wiring diagram of electric circuits, and a photograph of the boat running; 900 words.—*The Marine Review,* September.

British and German Torpedo Craft.—A discussion of military and tactical qualities rather than engineering considerations. States the relative strength of the British and German navies in torpedo craft, and discusses whether the margin of safety for British interests is sufficient in this line. Lists the more important classes of such craft in both navies; 2,800 words.—*The Engineer,* September 8.

The Argentine Battleship Rivadavia.—A brief detailed description of this interesting ship being built at the yard of the Fore River Shipbuilding Company, and launched there the 26th of August. With a length of hull of 585 feet; beam, 93 feet, and normal draft 27 feet 6 inches, her displacement will be 26,500 tons. Propelling machinery consists of turbines driving triple screws, a separate engine room being provided for each set. The designed speed is 23 knots. 1,200 words.—*The Engineer,* September 15.

Naval Architecture.

The Rolling of Ships.—By Professor J. H. Biles. Address to the Engineering Section of the British Association for Advancement of Science. An effort to account for the disappearance of ships at sea, of which no record is at hand for the cause of their loss, by a study of the known conditions of stability of the vessels and their probable behavior under different conditions of waves. The work is entirely analytical and follows the theory of Froude in his calculations of the angle of inclination produced by a train of waves. The results of experimental work by Colonel Russo of the Italian navy shows that by changing the initial conditions an almost infinite number of results might be obtained. 3,800 words.—*Engineering,* September 1.

Our Present Knowledge of the Vibration Phenomena of Steamers.—By Dr. O. Schlick, M. I. N. A. Read at jubilee meeting Institution of Naval Architects. A brief review of the complete subject as investigated by Dr. Schlick in his long experience with the vibrations of ship machinery. Beginning with the earliest forms of the problem, when torpedo boats, with reciprocating machinery, caused their designers to take account of the oscillations produced by engines and propellers, the various phases of the question are dealt with up to and including the more complicated ones which the turbine have introduced. The author explains vibrations of the first, second, third and fourth orders, and treats comprehensively of their causes and remedies. The analytical side of the question is passed over, and the whole paper is one of practical help for the engineer who must overcome the inconveniences caused by unbalanced engines or untrue propeller blades. The latter cause is more common than generally supposed, and very often the machining of a wheel causes a disagreeable shaking to disappear. This remedy and care in placing machinery in a hull so that vibrations of hull and machinery may neutralize each other are urged by Dr. Schlick as a remedy. 5,600 words.—*Engineering,* September 1.

Marine Engineering.

The Marine Steam Turbine from 1894 to 1910.—By the Hon. Sir Charles A. Parsons. Read before jubilee meeting Institution of Naval Architects. Gives the paper in full, which is a complete detailed account of the vessels engined by the Parsons turbine all over the world. Beginning with the formation of the first turbine building company in 1891, the author carries out each step in the development until the latest contract. Attention is paid in detail to figures showing relative economy of turbine and reciprocating engines under various conditions, merchant ship types best suited to turbines and the results obtained, reduction gearing, its scope and results. The types of turbines are considered and compared both in theory and in the results of trials.

Article contains plots showing economy and diagrams of comparative sizes of war and merchant ships fitted out and turbines installed; 8,500 words.—*The Marine Review,* September.

Diesel Engines for Sea-Going Vessels.—By J. T. Milton, vice-president Institution of Naval Architects. The last instalment of a series which evidently gives the paper in full. In this part the author takes up the points of design to be considered for marine Diesel engines. After a consideration of the effect different types of Diesel engines have upon the bending and twisting moment, the design of crankshafts is taken up in some detail. The question of air pump design is considered from the standpoint of emergencies and providing for air compression in case one pump became disabled. 3,300 words.—*The Steamship,* September.

The Steam Engine Contra the Internal Combustion Engine.—By H. C. Vogt. States that while the great thermal economy of the internal combustion engine is well known that the steam engine is still the most easily maneuvered, and may still be made more efficient by carrying out more carefully things that are already well known about its design. Mentions superheating and the scheme of taking steam from low-pressure cylinder direct to superheater and thence into turbine before returning to boiler. Then he considers points of boiler design, mentioning a series of experiments performed in Copenhagen upon model boilers of different types of the same size and under the same conditions which lead him to think the locomotive and small-tube express types the most efficient from the standpoint of theoretical design. Suggests improved points in the design of both types. 2,400 words.—*The Steamship,* September.

The Economics of Steamship Propulsion.—By Andrew Hamilton, M. I. N. A. The title of this article indicates very accurately what it contains. Mr. Hamilton considers the design of the power plant of a ship for given requirements and gives the cost per indicated horsepower for different types of installation, considering in the order named the engine, turbines, boilers, fuel oil burning, and producer gas engines. He takes up the tendency to design even tramp steamers of the present day with finer forms forward in order to save a part of the first cost of larger power plant which would otherwise be required. Under each of the divisions considered he states the weight generally required and the cost complete. 3,900 words.—*The Steamship,* September.

Diesel Marine Engines.—By Herr Th. Saiuberlich. Read before Schiffbautechnische Gesellschaft. In this, an extract of the original article, is given a review of the Diesel engine field at the present day, and then describes and shows several drawings of the service boat *Frerichs,* built by J. Frerichs & Co., for service on the North Sea. The boat is about 55 feet long, and is driven by a 4-cylinder, 4-cycle Diesel engine, direct connected to shaft and turning 360 revolutions per minute. At this speed it develops 200 effective horsepower, which drives the boat about 10 knots. Total weight of machinery about 10,000 kilograms. The operating mechanism is of the simplest and the engine is reversible. Special attention was paid in the design to cheapness of construction and simplicity of operation. 1,600 words.—*The Steamship,* September.

Internal Combustion Engines for Ocean-Going Ships.—The first article of a series in which the author will describe the ocean-going ships fitted with oil engines. In this is a list of such vessels now under construction and drawings, photographs and details of one from the list, the *Toiler,* built by Messrs. Swan, Hunter, and Wigham Richardson, for service on the American Great Lakes. With dimensions of 248 feet by 42 feet 6 inches by 19 feet depth molded, she carries 2,600 tons deadweight on 14 feet draft, which is the limiting condition imposed by the Welland Canal. In outward appearance this vessel resembles the usual type of lake freighter except that there is no funnel. Internally, everything is different. Propelling machinery consists of two Diesel engines of 180 brake-horsepower, each driving twin screws at 250 revolutions per minute. Weight of this plant is said to be only one-half that of steam giving same power and fuel consumption one-fourth that required of coal-burning motive power. Article also includes description of the *Electric Arc.* Both vessels illustrated with photographs and drawings. 3,300 words.—*The Shipbuilder,* summer number.

Eight Hundred-Horsepower Diesel Marine Engine.—Built by Richardsons, Westgarth & Company for a boat being built for Sir Raylton Dixon & Company, Ltd. The engines are of the two-cycle, single-acting type, with four cylinders 20 inches in diameter with 36 inches stroke. At 115 revolutions per minute they are expected to give 800 brake-horsepower. In general appearance they are very much like steam marine engines of the same size, the usual marine design being followed as closely as may be, for ease and reliability of operation. Auxiliary machinery is driven by steam. Carrying capacity of the vessel complete will be 3,150 tons. The owners have several boats of same class and size with different types of power plant, and comparisons of this with them will be interesting. 800 words.—*The Engineer,* September 15.

Electric Drives for Screw Propellers.—By H. A. Mavor. A study of the principles of economic propeller design in combination with engines with high rotative speeds, showing the advantages of an electrical system of power transmission. The author holds patents covering a system of electrical transmission whereby power from several power units may be used by one or more propellers. Describes in brief three vessels, designed or building, in which these ideas are carried out.

Frieda, turbo-electric steamship for American owners; 300 feet long, with deadweight capacity of 5,000 tons; speed, 12 knots. Turbo-electric set is for 1,500 kilowatts, three-phase, 50 cycles, running at 3,000 revolutions per minute. Working pressure is 200 pounds per square inch, and vacuum 28½ inches. Auxiliaries are motor driven. Main shaft driven by three-phase motor, capable of 1,900 brake-horsepower at 84 revolutions per minute. This equipment costs and weighs less than the normal equipment. The coal saving is 10 tons per day.

Oil-Electric Tank Barge for Canadian Service. Machinery for this boat consists of three Diesel non-reversible engines, each direct connected to an alternating-current generator. The current from these are led to separate windings in a motor keyed to the single propeller shaft, which turns at a slow rate. By using one, two or three motors the advantage of full power economy is secured while running at less than full speed. The cost of this installation is about 10 percent more than normal, but the carrying capacity of the barge is said to be greatly increased.

Electric Installation on United States Navy Collier, a plant, which is being installed in the collier being built at the Mare Island navy yard, consisting of a 5,000-kilowatt steam turbo-alternator. Current is led to two motors, one on each shaft. Steam is supplied by Scotch boilers. Cost, weight and economy are said to be better than for normal reciprocating engine outfit. 1,700 words.—*Engineering,* September 8.

Electrical Steering.—By B. Parker Haigh. Read before B. A. A. S. Discusses the conditions under which a steering gear works and what might be expected of a power gear. Classifies electrical steering gear as follows:

A. Steering gears in which the motor is started and stopped for every motion of the rudder.

1. The motor being supplied with current at variable voltage from a special generator.
2. The motor being controlled by reversing switch and resistances.

B. Steering gears in which the motor is kept running continuously, mechanical control being introduced in one of the following forms:

1. Friction clutches with gearing.
2. Hydraulic transmission with pumps.
3. Magnetic friction clutches on motor shaft.

The author regards the types under *B* heading to be the most practicable, and proceeds to consider questions of design for such machines. He is the inventor of one type of magnetic clutch machine, and gives results of tests on this gear. Illustrated; 3,000 words.—*Engineering,* September 8.

Floating Crane for Unloading Ore.—Built by John H. Wilson & Company, of Birmingham, for unloading ore at Huelva, Spain. Designed to lift 7 tons at 42 feet 6 inches radius. Power is supplied by double-cylinder engine, 8 by 12 inches, taking steam from a vertical cross-tube boiler working at 100 pounds per square inch. Speed of lifts with full load is 80 feet per minute, and with light load 200 feet per minute. The barge on which crane is mounted is 90 feet over all, 41 feet extreme breadth, and 8 feet deep. The framing is 3 by 2½ by 6/20 inch angle steel, spaced 24 inches on centers. Reverse framing is 2½ by 2½ by 5/20 inch angle. Bracing below deck is furnished by four athwartships and two fore-and-aft bulkheads. Design provides that with greatest load at greatest angle from center line the angle of cant is not over 1 degree. Freeboard not less than 3 feet. Shows photograph and drawing of general arrangement; 800 words.—*The Marine Review,* September.

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Chain Towage on German Rivers.

Conditions on German rivers are somewhat peculiar, because during certain parts of the year the depth of water becomes exceptionally low and at other times, when the water is high, the speed of the current increases to such an extent that navigation up-stream by an ordinary type of shallow draft boat becomes somewhat difficult. In the early days of river navigation a system of chain and rope towage was devised to meet these conditions, so that steam tugs fitted with a mechanically operated drum, or wheels, would wind themselves and a tow of barges up the stream along a rope or chain that was permanently anchored in the river. This is an unusual kind of towage, and at the present time its use in Germany is decreasing. In fact, the method of rope towage was abolished several years ago, although the method of chain towage still exists, and continues to prove a profitable method of carrying on river traffic.

On rivers of other countries most of the towing is done by shallow-draft, side or stern-wheel paddle steamers or tugs fitted with screw propellers, and, where fuel is cheap and there is no immediate necessity of special refinements in the design of the propelling machinery, this system of towage is very successful. The principal advantage of the chain towage, however, over that with the paddle or screw lies in the avoidance of slip, and where there are fast-flowing currents and small depths of water this matter becomes important. When using the chain method of towing, the propulsive efficiency of the tug is affected only by the ordinary resistances in the engine itself and the losses in connection with the transmission, together with certain losses due to the raising and stretching of the chain or to slipping. In this way the actual coal consumption of the chain tug becomes only about one-third that of a paddle tug when the tow is going up-stream. On the other hand, there are disadvantages in the method of chain towage which at first seem difficult to overcome. The type of boat is unsuitable for any other use, and the heavy first cost of the propelling machinery, including the chain or rope and the maintenance of this equipment, offset, in a measure, its advantages.

Full details of this type of river towage are illustrated and described in this issue, and in the next issue the rope tug will be taken up. There is a marked difference between the tugs used for these two methods of towing, in that the rope tug is equipped with twin screws to enable it to make the down-stream trips independently of the rope, while on the up-stream journey the combined rope and screw propulsion can be used. On the chain tug, propulsion both up and down-stream is obtained by winding the chain over the drums and wheels, special appliances being provided for detachment when an up-stream boat meets a down-stream boat. The chain is usually carried over the center line of the boat, and engine-driven water turbines are installed on each side to provide jets of water to assist in bringing the boat around sharp bends. The direction of the jets can be changed by an adjustable elbow, and they can be used for direct propulsion when necessary. The abandonment of rope-towing service on German rivers indicates that the chain towage will also be given up before long, chiefly on account of the increasing competition of the railways and the modern development of the paddle and screw tugs, combined with improvement of the rivers and the conditions for navigation. But wherever conditions are found similar to those which formerly existed on the German rivers this method of towing can undoubtedly be utilized for the cheap transportation of freight.

Inland Waterway Traffic.

Inland waterway traffic is a subject which is now being widely discussed in many countries. A hasty glance at the various types of shallow-draft boats presented in this issue, which are designed for service in various parts of the world, will give some idea of the great variety of conditions which affect the type of river boat to be built. Much of the expansion of river

traffic dates back to an early period before railroad transportation became a serious rival; this was particularly true in the United States, where the Western rivers at one time were practically the only means of transportation of freight from certain sections of the country to the sea coast. That this has not been maintained, however, is due to the rapid development of efficient railway traffic and to the lack of co-operation between the railroads and river steamboat companies.

Everyone recognizes the cheapness of freight transportation on open rivers, but if the river does not form a direct connection between some great productive center and the seacoast ports there is not much to stimulate water traffic unless the railways can be depended upon as feeders and the various river ports developed into efficient terminals adequately equipped for the storage and transsshipment of freight economically. With such conditions, river ports would not be destinations for either railroad or water traffic, but the entire system of transportation would be a combined rail-and-water system. This system has been developed on the two great rivers in Germany, and from the results obtained there it is shown very plainly that success depends upon the maintenance of a clear, open channel in the rivers, the establishment of good terminals, with facilities for storing and handling freight, and the transmission of freight from rail to water. It is not necessary to provide a great depth of water for inland navigation, as boats can be designed for efficient work on very shallow draft. Most freight transportation on inland waterways is carried on by towage. On the Western rivers in the United States immense cargoes of coal are carried in this way from Pittsburg to New Orleans in tows, which consist of from twenty to thirty barges fastened together four abreast and five or six fore-and-aft, with a single stern-wheel steamer at the stern to act as tug and rudder. In Germany much of the cargo is carried up the lower portions of the Rhine in small sea-going steamers and in barges and lighters from 600 to 1,500 tons, which are towed by single-screw tugs of the type described elsewhere in this issue. On the upper portions of the river express freighters of the side-wheel type carrying 6,000 tons of cargo are used, while through the rapids chain towage is in vogue.

Packet or express freight service is carried on in a variety of ways according to the volume of commerce and the natural conditions. On American rivers this traffic has been largely depleted in recent years by the competition from railways; but the old stern-wheelers, which were so numerous in ante-bellum days, still predominate. Freight is carried on the main deck of these boats and partly in the holds, the hurricane and texas decks being devoted to passenger accommodation. Part of the main deck space is occupied by the boilers, engines and fuel bunkers. Since the channels in the rivers on which these boats operate are continually changing, and the depth of water varying so that new obstacles are always met, the type of boat which originally proved most efficient for meeting these conditions will probably remain in use until clear, open channels can be maintained. Boats of this type always make their landings bow-on, and the cargo is loaded and unloaded by trucks over a long landing stage or gang plank. Since the freight is piled on the open levees, no opportunity is given for mechanical handling. On German rivers, however, the express freighters are similar to the tow boats, except that they are of higher speed. Deck hatches are accessible to cranes on shore, which handle the freight and transfer it to wagons or railway cars. There are many rivers in all parts of the world where a large volume of small shipments is carried by gasolene (petrol) motor boats. In America many of these boats are of the stern-wheel type, with horizontal engines of the stationary type connected to the paddle wheels by a combination belt and chain transmission for propulsion. Vessels of this type are also used for ferry work and as tramps where there is sufficient traffic. Many shallow-draft motor boats, with screw propulsion, are used for tow boats with small flats or barges which are suitable for handling a considerable volume of bulk cargo. In the rapid improvement in mechanical features of this class of boats it is to be expected that more river traffic will be developed in the near future. Heavy oil engines, which are now being perfected, will add much to the possibilities of this traffic.

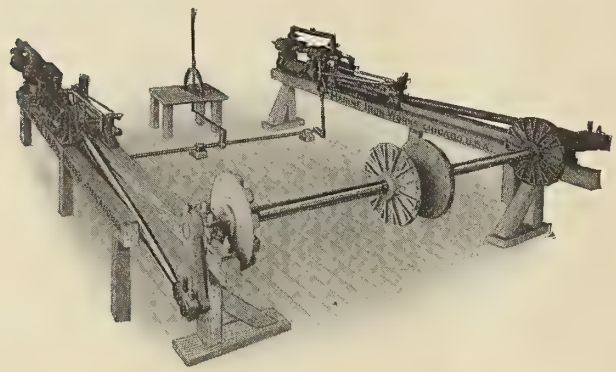
Besides the actual navigable rivers for shallow-draft navigation, the recent improvement of inner-coastal routes on the Atlantic Coast of the United States will open a new means of inland traffic. If the proposed improvements in these waterways are soon completed, there will be a complete through-line, which is navigable with safety the year round from Boston, Mass., to Richmond, Va. Losses from sea transportation between these points in the last two decades indicate that the safety of such a service will easily repay the cost of new construction, and, on account of the savings resulting from its operation, increased waterborne transportation should rapidly ensue.

All inland waterway transportation depends upon the establishment of complete and economical terminal systems, designed and equipped so that bulk and package freight can be handled quickly and cheaply and with a minimum amount of damage to the goods. Individuals and corporations cannot accomplish this at once, but Federal, State and municipal aid must be obtained and the faith of the people interested in commercial, industrial and transportation must be aroused to the economical advantages of a properly equipped inland waterway traffic where the terminals are controlled so that they can be used freely and impartially by all carriers, whether by rail or water. With this the advantages of improved waterways and of the improved designs of shallow-draft boats, which are illustrated in this issue, can be utilized.

ENGINEERING SPECIALTIES.

Centralized Valve Gear for Stern Paddle-Wheel Engines.

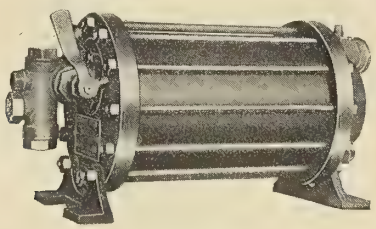
Light-draft river boats, especially those of the stern-wheel type, when used in rivers where there are overhanging trees and considerable foliage on the banks, frequently meet difficulties by entangling these obstructions with the eccentric or cam rods and causing breakdowns. Builders have attempted to correct this difficulty by using makeshifts, but a new type of valve gear has been placed on the market by the Marine



Iron Works, Chicago, Ill., which is designed to do away with this difficulty. As can be seen from the illustration, eccentric rods, cams and links have been eliminated, so that damage to the valve gear by obstructions is impossible. Also the length of the paddle wheels can be increased, as no space is required for the eccentrics or cams. The valve gear itself is in sight of the engineer and is accessible. The valves have a variable cut-off, which enables greater economy when the engines are operated under normal load, and also admits increasing power when circumstances demand an overload.

The Lytton Steam Trap.

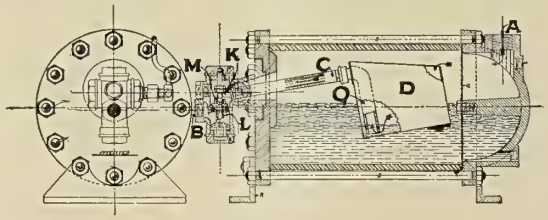
In the operation of a steamship the thorough draining of the water of condensation is fully as important as any other feature in the power plant, and unless it is thoroughly done danger to the engines, leaky joints in the piping, insufficient duty from the heating surface, when required for heating or drying, are some of the most important difficulties to contend with. The Lytton steam trap for draining condensed water, which is illustrated, is so built that all the working



EXTERIOR VIEW.

parts, with the exception of the bucket float alone, are on the outside of the receptacle, and, therefore, in sight and readily accessible, so that any possible troubles, which may happen even in the best of apparatus, can be immediately located and corrected without the necessity of pulling the trap to pieces. Also by this arrangement many of the automatic functions of the trap can be performed by hand from the outside, so that if any solid matter has lodged under the valve during discharge it can readily be removed by submerging the float and allowing the trap to flow through for a short time.

In operating the trap, when it is first installed, it is necessary to either fill the receptacle approximately one-half full of water or to hold the hand lever forward, which will raise the float *D* and allow the discharge valve *L* to remain closed until sufficient condensation has flowed from the cistern to the trap to support the float in the position shown in the sectional view. When this condition has been established, the water flowing through the trap in the inlet opening *A* will raise the float *D* until it strikes the outer casing. When the trap is filled, the water will flow into the float, causing it to drop to the bottom. This will cause an upward movement of the lever *K*, which raises the auxiliary valve *M*, and admits



SECTIONAL VIEW.

the pressure in the trap to the under side of the piston top to the main valve *L*, which opens the main valve and the water flows out of the trap. The water will flow from the trap until it is level with the top of the float with the float at the lowest position, when, almost instantly, sufficient water will be drawn out to raise the float again, thus closing the discharge valve until the receptacle is again full and the float drops.

Besides the features already referred to, the manufacturers of this trap, the Lytton Manufacturing Corporation, Franklin, Va., call particular attention to the way in which the valve operates, since all the float has to do is to raise the nickel auxiliary valve, admitting pressure to a piston having a larger area than the main valve, so that the pressure lifts it from its seat. Thus, since the discharge valve is practically balanced, its size is not limited by the pressure, and a large valve opening is therefore obtained with a consequently increased discharging capacity.

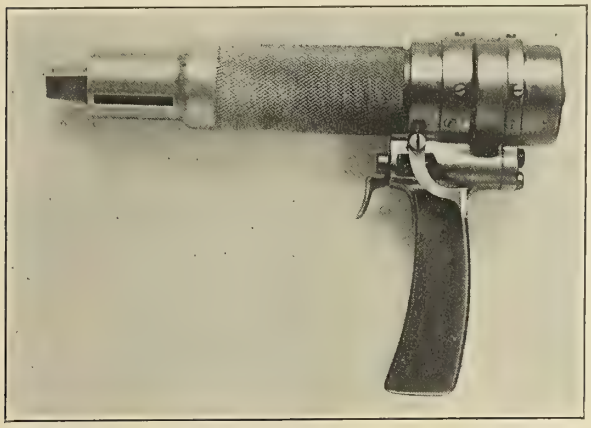
A Condenser Packing Tool.

A leaky condenser is something which causes as much trouble and irritation on board a ship as any single mishap. The cause of leaking can be traced to many sources, but a very prevalent one is that the packing laces are not carefully laid in. It is a tedious job, and carelessness after hours of the work is almost pardonable.

Mr. Edward P. Strode, of Fortieth street and First avenue, New York, has invented a tool for inserting condenser tube packing which makes the work an actual pleasure. Ten to twelve tube ends can be readily packed per minute, and experts have packed more than twice this number in the same time. What is of the utmost importance is that each tube is packed precisely like its neighbor. Broadly speaking, the packing tool as shown by the illustration is a pistol. It is loaded with a lacing, which then shoots into the tube plate around the tube, and by a blow sets it there. The tool is simple in the extreme, and unless absolutely abused would last for years. It is actuated by compressed air at 80 pounds pressure.

Looking at the illustration at the left of the tool will be seen a tapered square, followed by a round portion, which is slotted from end to end. To the right is seen a trigger, very much in the same position as it would be in a pistol, and on the front and side of the handle is a second trigger. In the bottom of the butt is tapped a hole to receive a coupling for

the air tube, the handle, of course, being hollow. The tapered square is inserted in the condenser tube, which brings it to a center. If this portion was left round, the little burr often left by the cutting-off machine would prevent proper centering. Just inside the slot, on the cylindrical portion, is a shaft, which, when the thumb trigger is pressed, admits air to a little turbine at the back, which causes it to revolve rapidly. A lacing is cut to length and inserted at the end of the slot, where it is grasped by a spring clamp and is whisked out of the side in a second. The second trigger is then pressed, and a little plunger which envelops the rotary portion shoots for-

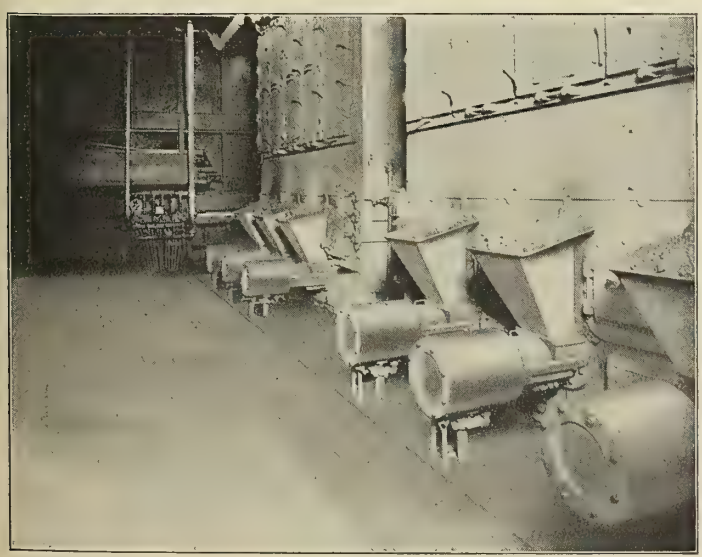


ward, sliding the coiled lacing off the rotating part and over the condenser tube, setting it firmly in place. The side trigger is then pressed again, giving a second blow, and the work is done.

The machine is simple. The little valves are only ordinary bevel seated affairs, which can be reground most advantageously, and the rebound of the plunger or hammer is accomplished by means of a coiled spring, which is only pressed a distance equal to the depth of the tap holder in the tube sheet.

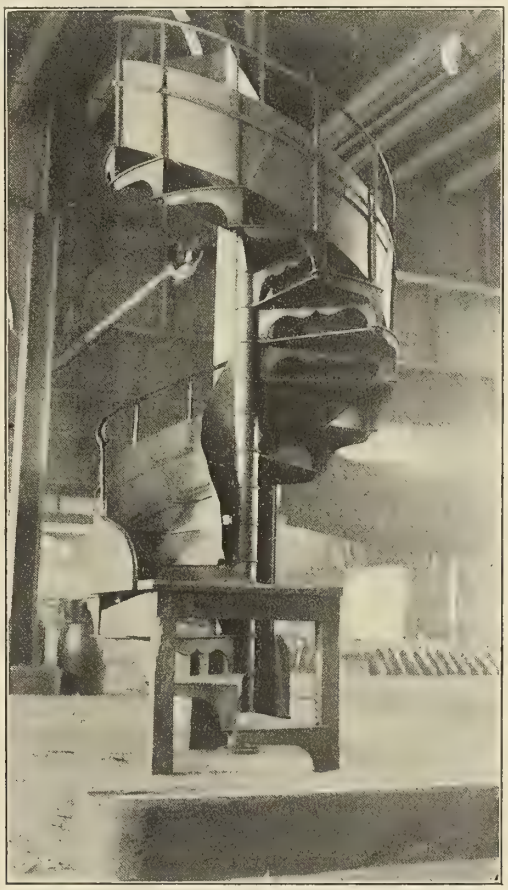
Machine Versus Hand Method of Stoking.

One of the best features of the best mechanical stokers is that they do not throw any green coal upon the fire itself. Matters are so arranged that the coal is coked by the time it reaches the incandescent bed of coals. It is doubtful whether a human stoker could properly take care of this matter. It seems probable, on the other hand, that with the highest type of mechanical stoking grades of coal can be used which would otherwise have to be wasted. This has been proved in many instances on shore, and the same is undoubtedly true on board ship. In one instance a 6,000-ton lake freighter, having two Niclausse watertube boilers, each containing 3,340 square feet of heating surface, was equipped with Jones stokers supplied by the Under-Feed Stoker Company of America, Chicago, Ill., as shown in the illustration. When these boilers were first installed they were stoked by hand, and the coal consumption for round trips between the head of the lakes and Lake Erie ports amounted to about 400 tons of slack coal. The use of the mechanical stokers, however, resulted in a marked increase in economy, as with them the fuel consumption for the round trip was reduced to about 300 tons of slack coal, or a gain in economy of 25 percent.



A Useful Freight Chute.

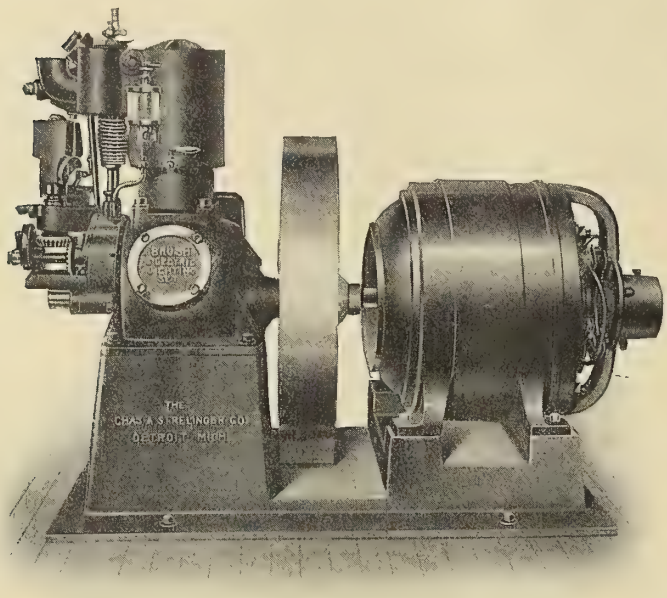
The illustration shows a freight chute constructed by Mr. G. A. Swain, superintendent of delivery piers of the Southern Pacific Company, at their New York terminal, for use in the delivery of small freight from the warehouse lofts to the main floor of the piers. These piers were equipped with straight wood chutes, but their use demonstrated that the



straight chutes were too rapid for small bags, namely, rice, beans, dried fruit, meal and lightly-constructed case freight, so the iron spiral staircases leading from the main floor to the lofts were utilized by fitting galvanized iron chutes onto the steps, with a landing platform at the foot of the staircases. These chutes have been in operation for about six months, and are said to have proved of great advantage, eliminating damage to the various light commodities handled on the piers.

The Brush Electric Lighting Set.

In our July number we made some mention of an installation of the Brush electric generating set in a vessel on the Pacific Coast, the outfit being used not only for lighting but running a wireless telegraph plant and other electrical conveniences. The capacity of the lighting set referred to was 4 kilowatts, and the makers (The Charles A. Strelinger Company, Detroit, Mich.) have since that time developed and placed upon the market a 2-kilowatt lighting set, consisting of a 4-horsepower engine direct connected to a 2-kilowatt generator, and which is illustrated herewith. Its capacity is sufficient for a maximum of 100 16-candlepower tungsten lamps, or a lesser number of lamps may be used in connection with many other electrical devices. This outfit is extremely compact, requiring a space of but 40 inches in length and 22 inches in width, the total weight being about 680 pounds.



Corrections.—In the description of the A. C. generators and induction motors, manufactured by Messrs. T. W. Broadbent, Ltd., Huddersfield, which was published on page 292 of our July issue, the statement that these generators delivered from 6 kilowatts at 750 revolutions per minute, etc., should read "from 60 kilowatts at 750 revolutions per minute, etc."

On page 388 of the October issue the caption for Fig. 2 should read 1,500 horsepower instead of 15,000.

On page 403 the caption of the illustration should state that the lightship illustrated is off Cape May instead of Cape Ann.

On page 404, in the third paragraph and seventh line, "adherent limitations" should be changed to "inherent limitations."

On page 404, in the cost of bids from the Fore River Shipbuilding Company, £164,000 should be £159,500.

On page 409, the displacement of the *Rochambeau* should read 17,300 tons instead of 70,300 tons, and the length over all 547 feet 9 inches instead of 597 feet 9 inches.

On page 251 of the June issue, in the article "Holtrop Automatic Lubricator," the end of the first sentence should read "cut in the box" instead of "cut in the shaft."

TECHNICAL PUBLICATIONS

The Gas Turbine. By Henry Harrison Suplee, B. Sc. Size, 6 by 9 inches. Pages, 262. Illustrations, 93. J. B. Lippincott Company, Philadelphia, Pa. Price, $3 net.

This work seems to us most timely, as the prime-moving world is tending most strongly to continuous-motion engines; and while the reciprocating motion of steam engines is coupled with certain inherent troubles, these are greatly augmented in the internal-combustion engine. Therefore, the rotary principle of a gas turbine is most alluring. In Mr. Suplee's book there is much which is of value, even if taken only as a collection of what has been attempted, let alone its admirable treatment of the subject educationally. The difficulties of a practical gas turbine are great, and we can agree with the author that the most promising road is that which leads towards the "mixed type," as he terms it.

The Design and Construction of Ships. By Prof. J. Harvard Biles. Two volumes. Size, 6½ by 9 inches. Pages, 846. Illustrations, 561. Plates, 40. J. B. Lippincott Company, Philadelphia; Charles Griffin Company, Ltd.. London. Price, two volumes, $15.

It would be utterly impossible to even briefly outline Prof. Biles' work and do it justice. While he lays no claim to originality, the information concerning old things is made to seem new by its clear and concise explanation, and throughout his book there is always that pleasant feeling to the reader that if he could only see Prof. Biles he would learn a great deal more. In other words, there seems to be a tremendous reserve force. The book grew out of lectures on the various topics delivered at Glasgow University. This, of course, would account for its clearness, and it is supposed to be especially adapted for students; but we venture to say that the practicing engineer finds himself often in as much need of clearness and conciseness as does the student, and to both the book of Prof. Biles is invaluable.

Cape Cod Canal. Size, 5⅛ by 8 inches. Pages, 64. Illustrations, 30. Maps, 2. Published by J. W. Dalton, Sandwich, Mass. Price, 25 cents.

This booklet is called an "illustrated story of the new Maritime Highway," a project first conceived by the Pilgrims, the canal that will make Cape Cod an island. The information, coupled with the illustrations given, is instructive and pleasantly imparted. It draws attention to making Cape Cod an island, and also to the fact that a large part of the Cape was at one time an island.

Handbook for Iron Founders. Issued by the Frodair Iron & Steel Company, Ltd. London. Size, 4 by 6½ inches. Pages, 126. Numerous tables. Price, 3s.

The publishers of this little handbook are people who make a business of foundry work, or, more properly, of cast iron mixtures. They are, in fact, advisory engineers, and while they recognize the value of analysis of iron and understand thoroughly the effect of silicon, manganese, phosphorus, carbon, etc., they are frank enough to say that this knowledge does not of necessity make a successful foundryman, and that foundry work is not yet an exact science. We quote from them as follows: "Laboratory tests may be vastly helpful in a foundry and may insure it against wide and serious divergences of result. It could never be expected that, in the case of any particular casting, a specification based on chemical analysis and physical tests could be laid down which would yield the desired result with absolute certainty. All founders are painfully aware of this, for even the most successful will from time to time have a casting to make, the difficulties of which

yield to no scientifically established rules, and are not overcome until after many failures and a good many hot arguments between foundry foreman, draftsman, chemist and pattern-maker." This refreshingly open and fair statement must inspire confidence. American and British authorities are quoted, and the information is so given that it is applicable in any country. The only criticism we have to make on the neat little volume is that owing to the use of gilt on the edge of the pages it would seem wise if the publishers would send an oyster knife with each volume in order to get at the valuable information contained therein.

Practical Marine Engineering. Third edition. Size, 6 by 9 inches. Pages, 794. Illustrations, 350. New York, 1911: International Marine Engineering. Price, $5.

Previous editions of this book have been found so valuable to marine engineers and students that it was considered desirable to publish a third edition involving some additions to cover recent developments of marine engineering and bring the subject matter up to date. The book was originally written by Prof. W. F. Durand, formerly head of the Department of Naval Architecture, Cornell University. The additions, which include chapters on steam turbines, internal-combustion engines, producer-gas plants and oil fuel, have been contributed by recognized experts in these various fields. Few books written on engineering subjects are intended to give detailed information from a practical point of view. They usually deal with the theoretical part of the subject that can be thoroughly understood only by those who have made a scientific and technical study of engineering. In this case, however, it was the purpose of the author to provide help for the operative or practical engineer, either for the man who has already entered the profession or who may wish to perfect himself more fully in many branches of the subject, or for the applicant for the lowest round of the ladder, or for the young man whose attention has just turned to this field and who may wish some simple and fairly complete presentation of the subject from the practical standpoint. To do this it was, of course, necessary to simplify the work and omit much of the material which could be understood only by those who have had the advantage of higher mathematics and engineering education. It is understood that the reader has some knowledge of the essential principles of marine engines, boilers, fuels, etc., not as a designer but as a user of the machinery.

The first part of the book contains an adequate treatment of the materials used in engineering construction, of the different kinds of fuels, and then goes on to describe the prominent types of marine boilers, with their accessories and relative performances. Following this, the principal discussion is of engines and auxiliaries, describing their individual parts, installation and uses. Operation, management and repair are treated in a single chapter, and this gives much valuable information to the man whose duties require the knowledge usually gained by wide experience on board ship. Valves and valve gears, steam engine indicators and indicator cards are treated in separate chapters. The principles of propulsion and powering are most important to the marine engineer, and can only be understood by a thorough study of the subject. In dealing with this the author has used many examples showing the methods of calculation for different types of propulsion and the means for computing the power for given types of ships. The first part of the book is concluded by chapters on refrigeration and electricity.

In Part II., which is called "Computations for Engineers," an elementary discussion is given of the mathematics necessary for this work. A general knowledge of the subject is presupposed, but the most essential points of this work are given and illustrated with many useful problems. This feature of the work is designed to be of help to those who wish to qualify as licensed engineers. In connection with this an appendix is added containing a list of questions which would be asked in an examination for such a position. References are given for the pages in the book which give the information necessary to answer these questions.

Part III., which is the new part of the book, has not been intended to give an exhaustive discussion of the subjects involved, but to present the general principles and describe the details of the machinery. In the chapter on turbines the prominent types of marine turbines are given in detail and actual installations illustrated. The auxiliaries required for turbine installations are also described in full. Similarly, with internal-combustion engines, the prominent types are described and the engines illustrated by photographs and drawings. The advent of gasoline and heavy oil engines brings a comparatively new subject before the marine engineer, and one which requires careful study for efficient operation. Producer gas plants are described rather briefly, giving particularly the method of generating producer gas and the type of engine necessary for using this as a fuel. In closing, a chapter is devoted to the specifications, methods of burning and stowage of oil fuel.

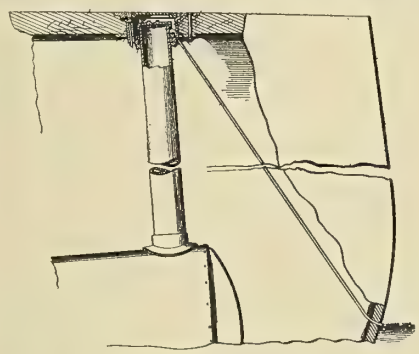
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

999,688. DECK-PLATE FILLER FOR VESSELS USING OIL FUEL. ALEXANDER WINTON, OF CLEVELAND, OHIO.

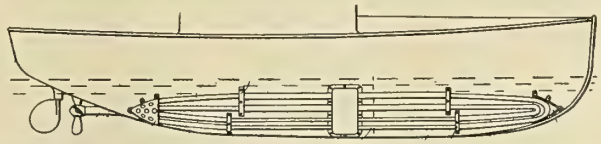
Claim 1.—The combination with the filling pipe of a fuel tank, of a deck-plate surrounding the filling end of the pipe, a cover for the deck-



plate, and a lock for the cover operated from the inside of the hull of the boat. Six claims.

1,000,310. OUTBOARD CONDENSER. CHARLES WARD AND CHARLES E. WARD, OF CHARLESTON, W. VA.

Claim 4.—In an outboard condenser, the combination with a boat, of a header secured to the side of the boat, the said header being divided into



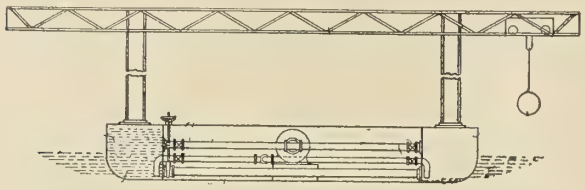
compartments, pipes extending a distance from one compartment of the header and returning to another compartment of the header, and means constructed and arranged to be operated from the interior of the boat for closing any number of the said pipes. Five claims.

1,000,198. ROWLOCK. LEOPOLD ROTHGERY, OF DETROIT, MICH.

Claim.—In a rowlock, in combination with a thole, a band ring pivotally secured thereto, a loom ring made in two parts adapted to engage through said band ring, the said two parts in their assembled condition being provided with a circumferential groove adapted to engage a holding member projecting inward from the band ring.

1,000,152. FLOATING DERRICK. FRIEDRICH CORRELL, OF NEW YORK, N. Y.

Claim 1.—In combination: a pontoon or barge; a derrick carried thereby, and adapted to control a load; a number of communicating compartments adapted to retain a liquid ballast; and means to control the



flow of same in such a manner that the pontoon is maintained in a substantially level position under various positions and conditions of the load. Thirteen claims.

1,000,786. METALLIC BOAT. FRANK H. DARROW, OF ALBION, MICH.

Claim.—In a boat, a sheet metal bottom and sides, said bottom and sides being secured together at their outer edges to form a fluid-tight joint, inner and outer end posts, the outer posts being triangular in cross section and arranged at the opposite ends of the boat and adapted to receive between themselves the inwardly bent ends of the side pieces, said posts being bolted together to firmly grip the ends of the sides, a series of ribs arranged in and secured to the bottom and sides of the boat, inner side rails secured to the upper edges of the ribs and to the inner end post, outer side rails secured to the upper edges of the sides and to the ribs, said outer side pieces being secured at their opposite ends to the outer end posts, and sheet metal fastening and protecting plates adapted to be bent into engagement with the outer end of the outer end post and with the engaging ends of the outer side rails. One claim.

1,001,476. LIFE-PRESERVER. JACOB STROBEL, OF NEW YORK, N. Y.

Claim 1.—A life preserver, having an air chamber provided with an inlet port, a valve controlling said port, a retainer for holding said valve in closed position, and means within said air chamber and operable from the exterior thereof, for moving said retainer to inoperative position. Six claims.

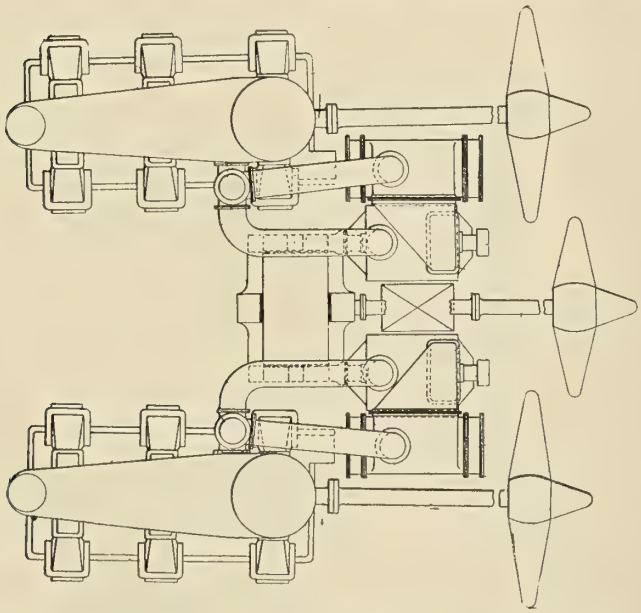
1,000,999. PROPELLER. OSCAR A. DANIELSON AND LYMAN R. JONES, OF NEW YORK, N. Y.

Claim 1.—The combination with a propeller and a shaft therefor, of means for securing the shaft to the propeller consisting essentially of an eyelet engaging the end of the shaft and the folded part of the propeller within which said end of the shaft is placed. Five claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton Building, W. C., London.

16,346. INSTALLATIONS FOR MARINE PROPULSION. THE HON. C. A. PARSONS, OF NEW CASTLE-ON-TYNE, AND S. S. COOK, WALLSEND.

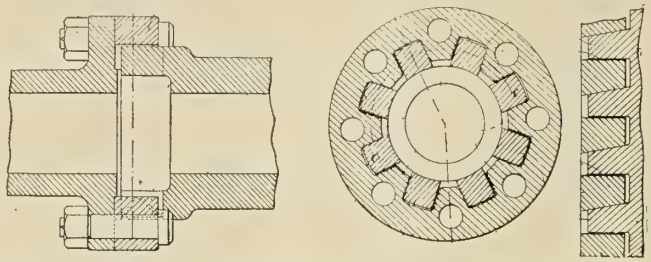
In operation, pressure fluid is supplied to each reciprocating engine; thence it passes by the pipes to the corresponding turbine, and the condenser. Going astern the engine on each side of the ship is directly con-



nected with its condenser, the turbines being idle. A reversing turbine thus becomes unnecessary. For maneuvering, the reciprocating engines can be operated independently either both ahead, both astern, or one ahead and the other astern. The turbine on the side of the engine running astern will run idly in the condenser vacuum, while that on the other side, when the engine on that side is running ahead, will also be running and driving the center propeller ahead, and this by its wash on the rudder will assist in turning the vessel.

17,068. MARINE PROPULSION. THE HON. C. A. PARSONS, NEWCASTLE, AND S. S. COOK, WALLSEND.

This is for a marine turbine installation having additional or cruising turbine parts connected to a propeller shaft by couplings such as shown



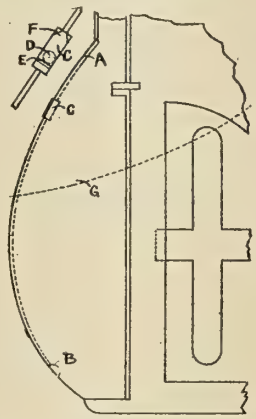
so that the added thrust produced by the power of the additional turbine parts may be balanced in these parts or transmitted to suitable absorbing means.

17,612. APPARATUS FOR CONTROLLING THE DEPTH OF SUBMERSION OF A BODY IN A LIQUID. J. R. DA COSTA, NEWCASTLE-ON-TYNE.

Relates to submarines, etc. The depths are marked on a stem, and any mark is brought to the pointer by turning the hand wheel. If the craft is below this level water will enter and raise the float, causing the disc to complete an electrical circuit, including the electro-magnet, which then opens a valve to admit compressed air for driving out some of the water from the balancing chamber. When the correct level is reached the water tends to leave the float, breaks the contact, and the valve closes. If the boat is above the required depth the float falls and is supported by the disc on hooks which make a circuit causing an electro-magnet to open a valve and allow air to escape from the balancing chamber and water to enter. The apparatus may be operated by hand.

18,408. MEANS FOR PREVENTING THE RACING OF MARINE ENGINES. P. DAVIS, CHESTER.

According to this invention, two pipes with valves intercepting the steam valve and connected with a slide valve to turn off and on the steam as the sea exposes and covers the propeller, are brought into instant operation by a tube open at the bottom and sunk into the outer edge of the rudder; this tube is carried up the rudder post and connected with an instrument for changing the course of currents of elec-



tricity called an electrepeter, the wires from which are connected with a switch and second electrepeter to tilt over from side to side by two motors and eccentric wheel attached to a frame connected to the slide valve and running in the groove of a fixed table over a continually oscillating bar running in the same groove, two adjustable bolts on the bar meeting the eccentric wheel and carrying the frame with the lever of the slide valve to turn steam off and on as required to prevent racing.

14,181. ELECTRICAL ARRANGEMENTS FOR PROTECTING SHIPS' BOTTOMS, ETC. J. E. JAMES, BOLTON.

Electrodes or current discharge points are carried by insulating devices fixed in the plates and these preferably discharge high-tension currents into the water from coils to produce a strong electrical field over a suitable area, the current returning via the vessel shell; return wiring, collecting points, etc., being dispensed with. It is found that alternating current of high tension is most destructive to low forms of aquatic life.

11,131. DEVICE FOR CALMING ROUGH SEAS BY MEANS OF OIL. G. DOLNE-DEHAN, SCLESSIN, BELGIUM.

A previous device for this purpose was a receiver filled with oil projected by a howitzer and open during its flight, the oil being kept in by the air pressure. This method does not allow a greatly inclined trajectory when the receiver capacity exceeds certain limits. Another receiver is kept closed during projection, the opening being effected by the shock to the device on striking water. This method also presents the same difficulty, as the shock would not be sufficient to open the receiver. These drawbacks are avoided by this invention, which consists in retaining the cover by spring hooks at the instant of projection, these releasing the cover as soon as the device is expelled. The cover is a plug of wood, and is held in place during the flight through the air by means of the air pressure, but floats on the water when the device strikes, thus releasing the oil. A modification is adapted for projection by hand.